RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

Howard P. Doub, M.D.
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Familial Fibrous Swelling of the Jaws[1]

JOHN CAFFEY, M.D., and JOHN L. WILLIAMS, M.D.

New York, N. Y.

THE FAMILIAL occurrence of painless enlargement of the jaws was first reported by Jones in 1933 (4) in three siblings, six, five, and four years of age. In 1938 (5) Jones reported later observations on the same family under the title "Familial Multilocular Cystic Disease of the Jaws." He concluded from roentgenograms that the condition was due to multiple dentigerous cysts affecting the entire upper and lower jaws and accompanied by chronic enlargement of the lymph nodes in the submaxillary regions. The disorder first became evident when the patients were between two and a half and three years of age. Earlier generations of this family had not exhibited signs of the disease. Jones mentions that Dr. P. J. Thomas of Savannah, Ga., had observed a boy with similar multilocular enlargement of both jaws; in this family, however, enlarged jaws were said to have been present in five successive generations.

In 1947 (7), Miller described hypertrophy of the jaws in a young man eighteen years of age, whose mother was similarly affected. In microscopic sections of the alveolar ridge, fibrosis was the dominant change. The roentgen findings are unknown and the clinical data are incomplete for this patient and his mother.

We have observed two families, some members of which have exhibited clinical and roentgen signs similar to those described by Jones in his cases; the findings in these two families are the subject of this report.

CASE REPORTS

CASE 1: L. O., a white boy 5-1/2 years of age, was observed in 1932 because of progressive painless swelling of the jaws. He was the youngest of four siblings and at birth required resuscitation following a difficult forceps delivery. Development was normal. The first tooth appeared at four months.

During the first year the child's jaws became large and they continued to increase in size. There had been no pain, tenderness, or limitation of motion. His teeth had always been irregularly spaced, and most of them became carious shortly after eruption. At about two years of age large swellings appeared in the neck, beneath the lower jaw, and these continued to increase slowly in size.

Physical Examination: The patient was well developed, well nourished, alert, and intelligent. His temperature, pulse, and respirations were normal. The lower part of his face was large and round, the cheeks were bulging, and there was a marked widening of the lower jaw at the angles (Fig. 1, A and B). Palpation revealed a smooth, bony-hard, symmetrical overgrowth of the maxilla, and of the mandible, especially at its angles. The overlying skin was not discolored, and the subcutaneous tissues were not palpably thickened. There was no tenderness or limitation of motion of the mandible. The teeth were poorly aligned and most of them were carious or broken. The alveolar ridges of both the upper and lower jaws were widened and the oral cavity was correspondingly small. The tongue did not protrude;

[1] From Departments of Pediatrics and Radiology, Columbia-Presbyterian Medical Center, New York, N. Y. Accepted for publication in June 1950.

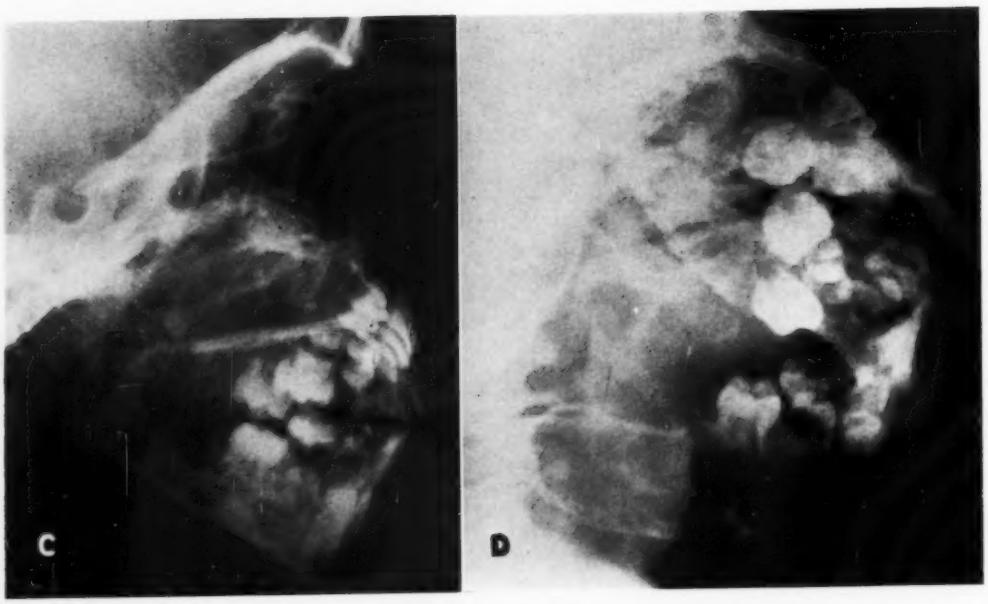

Fig. 1. Case 1, age 5 1/2 years. A and B. Photographs showing swelling of the cheeks, jaws, and submaxillary lymph nodes. The chin is not prominent.
C and D. Lateral and oblique roentgenograms of mandible showing multilocular rarefaction and expansion. The coronoid processes are very short. The condylar processes and incisor region are not affected.

the lips were everted and thickened. The tonsils and pharynx were slightly injected. The submaxillary lymph nodes were enlarged to a diameter of 3 cm., bilaterally. They were firm, non-tender, and movable.

The urine, hemogram, and hemoglobin content were normal. The Kahn reaction was non-syphilitic; in the skin there was no reaction to 0.1 mg. of tuberculin. The blood non-protein nitrogen was 37 mg. per 100 c.c. In several specimens of blood, the

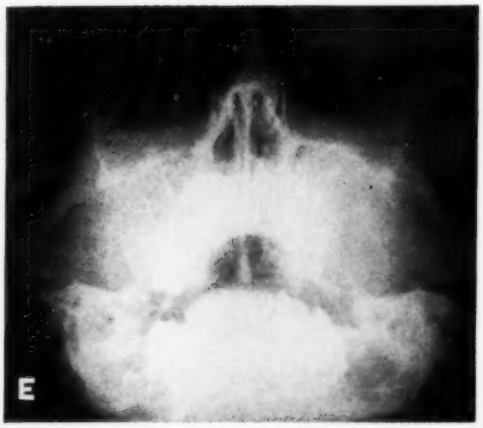

Fig. 1E. Case 1: Frontal film of face. The maxillary sinuses are extremely small. The lateral walls of the superior maxilla are so poorly mineralized that they cannot be seen.

average serum calcium was 10.8 mg. per 100 c.c., and serum phosphorus 4.6 mg. per 100 c.c.

Roentgen Examination: In the body and both rami of the swollen mandible there were numerous areas of diminished density, the margins of which were irregular but usually sharply defined (Fig. 1, C and D). This rarefaction was so extensive that in many regions only a few irregular trabeculae were visible, and the cortex was reduced to a thin shell. The coronoid processes were so short that the mandibular notches were virtually absent. The condylar processes and the incisor region of the mandible were not involved. On both sides the body of the mandible was expanded in the superior-inferior as well as lateral dimensions, and its external contour was irregular.

Films of the face showed the maxillary sinuses to be obliterated except at their upper medial corners (Fig. 1E). Only the roof of each sinus was clearly visible. The swollen superior maxilla, including its alveolar process, was so poorly mineralized that its shadow could not be satisfactorily seen. The rarefaction in the maxilla was even and diffuse, while that in the mandible was multilocular. The malar and other cranial bones were normal.

There was an advanced coxa plana in the right femur; the remainder of the skeleton was normal. Unfortunately, tissue specimens of the jaws were not obtained and there were no later observations of the patient.

CASE 2: M. O., the 14-year-old sister of Patient 1, also exhibited swellings of the jaws. The exact time of onset was unknown. Her facial appearance had improved with advancing age, but a slight deformity was still visible (Fig. 2A). There had been no limitation of motion or pain in the jaws.

Roentgen examination of the mandible showed multilocular areas of decreased density in the coronoid processes and in the rami (Fig. 2B). Both coronoid processes were moderately expanded, the one on the right side overlapping the last molar tooth to such an extent that eruption would have been difficult or impossible. The body of the mandible on the right side was normal in size and density, but on the left there were scattered areas of diminished density as far anterior as the premolar teeth. One premolar and two molar teeth were missing from the left side of the mandible. The maxilla appeared normal (Fig. 2C). The maxillary sinuses were well developed and their lateral and inferior borders were sharply defined. No dental films were taken, but in the oblique and Waters' projections of the maxilla, the teeth in the upper jaw appeared normal.

Fig. 2A. Case 2, age 14. Photograph of sister of Patient 1, showing similar but less marked facial swelling, especially at the angles of the lower jaw.

The remainder of the skeleton was not examined roentgenographically, and blood chemistry studies were not done.

CASE 3: E. O., the 38-year-old mother of Patients 1 and 2, stated that as a child her jaws had been as prominent as those of her children. The teeth in her lower jaw had been carious and poorly spaced, and all except three anterior ones had fallen out or been extracted many years previously. There was a slight prominence of the lower jaw at the angles, especially on the right side (Fig. 3).

Roentgen examination showed the coronoid processes to be so short and blunt that the mandibular notches were virtually absent. The body of the mandible showed a moderate irregular sclerosis. There were a few areas of decreased density but these were not sharply defined and there was no suggestion of a honeycomb appearance like that in Case 1. The trabeculae were more numerous than usual, small and tightly packed, and were not arranged in the

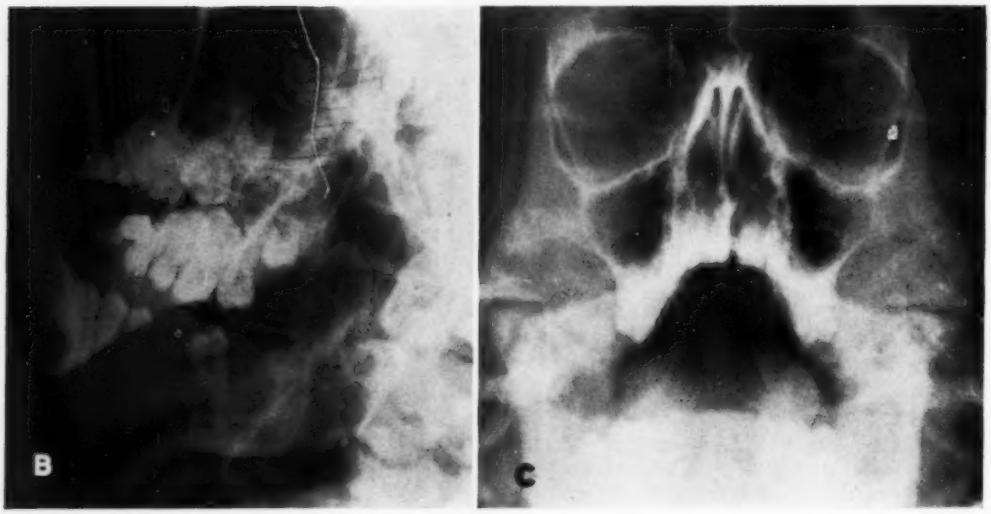

Fig. 2, B and C. Case 2. B. Oblique film of left side of the mandible, showing expansion and rarefaction of the coronoid process. Multilocular rarefaction is present in the body and ramus of the mandible. C. The maxilla is normal.

Fig. 3. Case 3, age 38. Mother of Patients 1 and 2. There is only slight residual prominence of the lower jaw on the right side, although marked swelling was said to have been present during childhood.

usual pattern. The mandible was not increased in size. The findings, with the exception of the short blunt coronoid processes, were not definitely abnormal, and the roentgenograms alone would not have suggested that the patient had ever had an extensive hypertrophic disease of the mandible similar to that of her children, although she was certain that, during childhood, her face was swollen in the same way.

No abnormalities were seen in the maxilla, and the teeth in the upper jaw were normal in number and alignment.

CASE 4: R. C., a Negro male, was born in Sloane Hospital on July 20, 1947, after a normal gestation and labor. His birth weight was 3,750 gm. Physical examination after delivery revealed no abnormalities; the face was not swollen. In routine roentgenograms of the skull and thorax made on the fourth day of life the jaws were normal (Fig. 4A).

The infant was bottle-fed and received supplementary vitamins. He gained weight satisfactorily and had no significant illnesses. Routine re-examination at six months disclosed no abnormalities. The first tooth appeared during the seventh month.

Another routine examination was done at thirteen months of age, when seven teeth were present. Dentition was slightly irregular and the lower teeth were separated, but no other abnormal findings were recorded. In a photograph at fourteen months the facial appearance was not unusual; the cheeks were fat, but there was no swelling of the jaws.

When the child was twenty-six months of age, his mother became aware of a slowly progressive painless swelling of his jaws and cheeks. He continued to eat well and was not irritable. During the following month, the lower teeth became loose and two of them fell out.

On Nov. 13, 1949, at twenty-eight months of age, the boy was admitted to Babies Hospital. He was alert, well nourished, and did not appear ill. Temperature, pulse, and respirations were normal. The lower half of the face was markedly swollen, especially in the regions of the cheeks and at the angles

Fig. 4A. Case 4. Lateral film of head on the fourth day of life. The mandible is not swollen or rarefied.

of the lower jaw. The mouth was held open, and saliva drooled from it. The sides of the mandible were greatly enlarged to palpation; the swellings were smooth, bony-hard, and non-tender. The maxilla was also visibly and palpably enlarged, but to a slightly less degree. Movement of the mandible did not cause pain. In the upper jaw there were eight normal teeth. The upper alveolar processes were wider than normal. In the lower jaw there were two loose molar teeth and three widely spaced incisors. The gums were thickened and thrown into folds; the oral cavity was correspondingly small. There was evidence of a moderately severe gingivitis. The alveolar ridges in the lower jaw were so wide that there was only a narrow mid-line groove for the tongue. This interfered with closure of the mouth and accounted for thick speech. The tongue itself was of normal size (Fig. 4B). The throat was not injected. Enlarged lymph nodes, measuring 2 cm. in diameter, were palpable below the mandible.

The urine, hemogram, and hemoglobin content were normal; erythrocyte sedimentation rate 4 mm. in one hour; blood non-protein nitrogen 39 mg. per 100 c.c.; serum calcium 11.1 mg. per 100 c.c.; serum phosphorus 5.7 mg. per 100 c.c.; alkaline

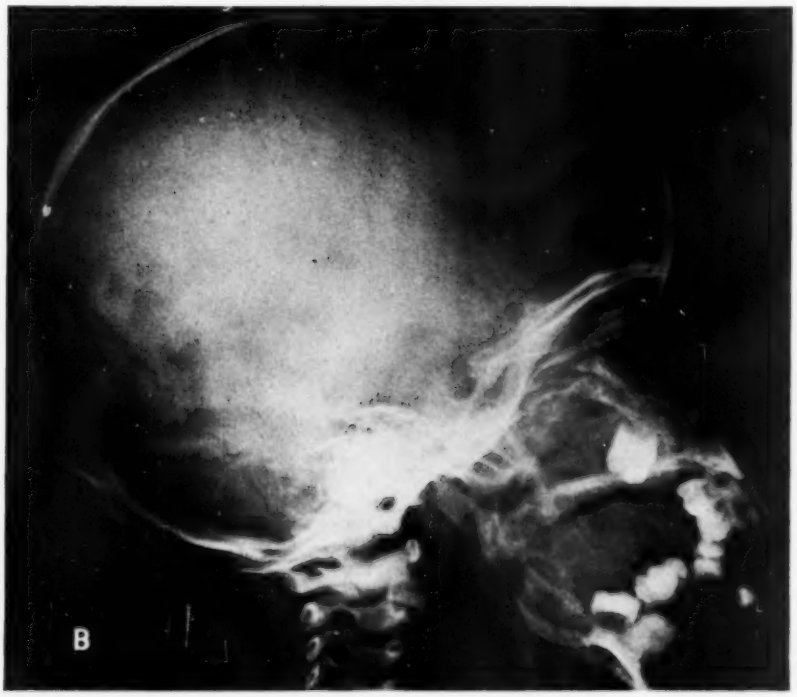

Fig. 4B. Case 4: Lateral film of head at twenty-eight months. The facial bones are disproportionately large and the jaws protrude ventrad. There is multilocular expansion of all the mandible except the condylar processes. The teeth are poorly aligned. An air-shadow outlines the inferior border of the elevated tongue (arrow).

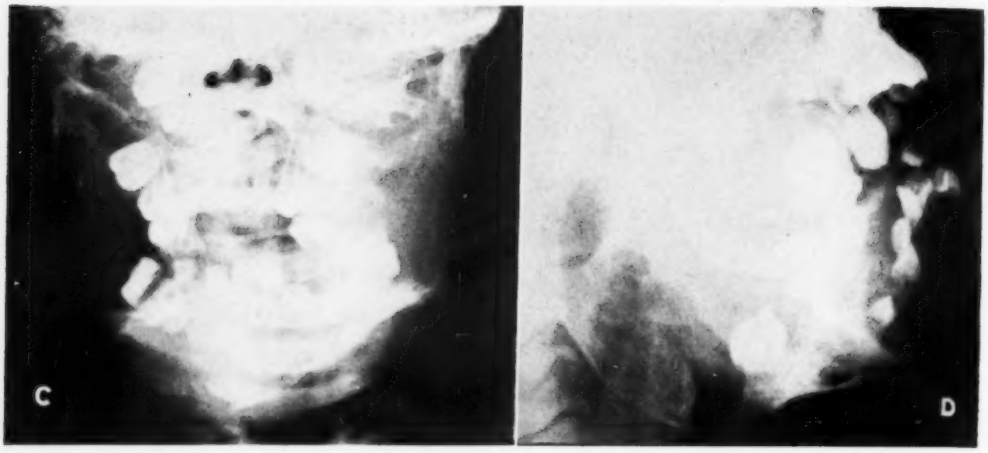

Fig. 4, C and D. Case 4. Frontal and oblique films of the mandible showing its multilocular expansion. The incisor teeth are suspended in tissue of water-density.

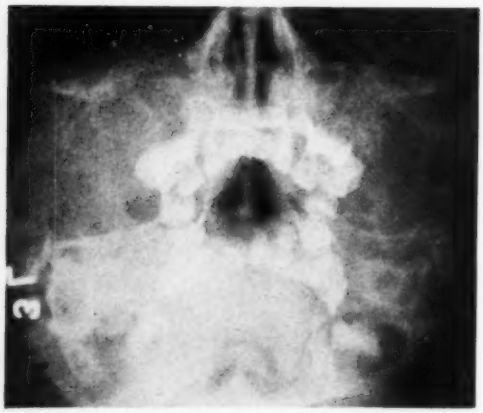

Fig. 4E. Case 4: Frontal film of the face. Only a few bony septa are visible in the maxilla, and the sinuses are almost obliterated.

phosphatase activity 14 Bodansky units. The Mazzini test was non-syphilitic. There was no reaction in the skin to 1.0 mg. of tuberculin.

Roentgen examination revealed extensive multilocular rarefaction in all parts of the mandible except the condylar processes (Fig. 4C and D). This was so marked in most areas that only a few poorly mineralized bony septa remained. The jaw was expanded in all directions and the cortex, where visible, was reduced to a thin shell. The amount of expansion was variable and consequently the edges of the jaw were irregular. In the region of the incisor teeth the anterior cortex of the mandible could not be seen and the teeth appeared to be suspended in the soft tissues. The coronoid processes were wide and blunt. The teeth were normally mineralized but most of them were ectopic and many of the dental follicles for the permanent teeth were absent.

In the maxilla there was so little mineralized bone that it was impossible to determine, from its shadow, the extent of its expansion (Fig. 4E). In the regions of the maxillary sinuses the bones could not be clearly seen, but faint trabeculae suggested that the superior maxilla was greatly expanded. The inferior margins of the maxilla were not demonstrable. Rarefaction also extended into the zygomatic processes of the maxilla. One maxillary sinus was obliterated and the other was reduced to an area of air-density 0.5 by 1.0 cm. at the upper inner corner of the superior maxilla. The rarefaction in the maxilla was diffuse and even, in contrast to the irregular multilocular rarefaction in the mandible.

In the upper jaw, most of the premolar and molar teeth were either ectopic or missing, and there was no roentgen evidence of follicles for the corresponding permanent teeth. Dentition in the incisor region appeared normal.

The skull and remainder of the skeleton were normal.

On Nov. 11, 1949, tissue specimens were taken from the mandible, maxilla, and gums; after surgical exposure, the walls of the maxilla and mandible were seen to be very thin. Most of the tissue of the jaws was soft and pliable, but some areas were rather firm and resembled cartilage in consistency. The pieces of tissue varied in color but were mainly yellow or yellowish-white. On microscopic examination the epithelium of the gum was normal. The sections from the mandible and maxilla were similar, showing irregular whorls and bands of fibrous tissue containing varying numbers of giant cells. In some areas the giant cells were quite numerous but in most regions there were only a few per high-power field. The number of nuclei in the giant cells varied from three to twenty-three. The microscopic

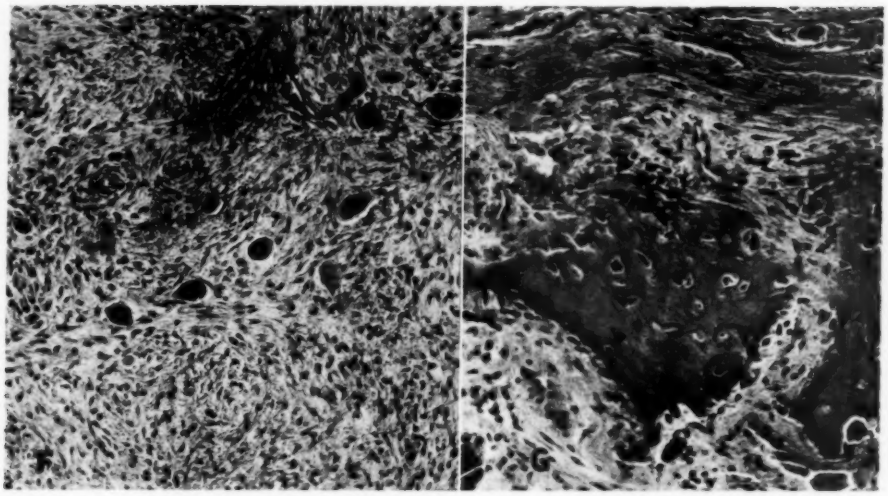

Fig. 4, F and G. Case 4. F. Photomicrograph of section from mandible showing fibrous tissue and giant cells. G. Photomicrograph through the thinned cortical bone of the mandible. Periosteum is at the top.

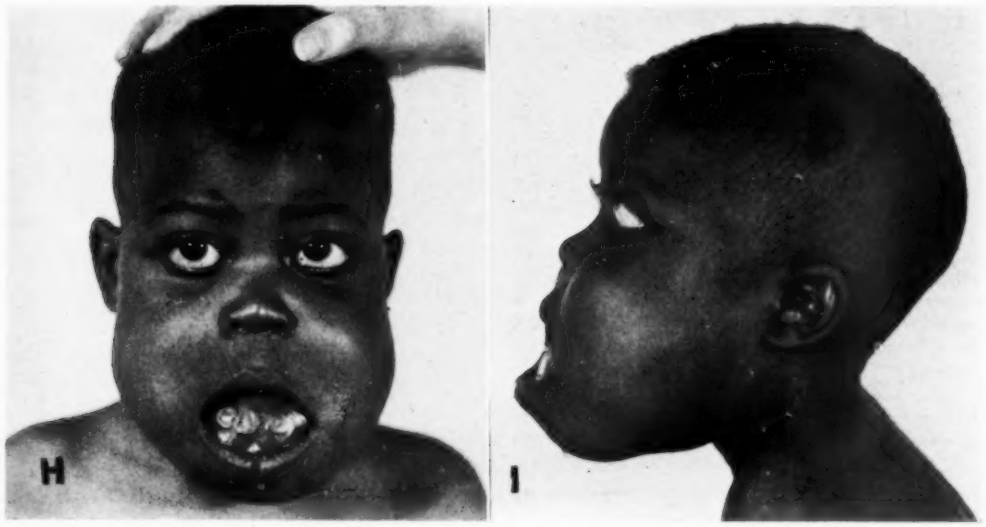

Fig. 4, H and I. Case 4: Photographs at thirty-four months of age. There is massive enlargement of the cheeks and jaws. The mouth cannot be closed.

changes are shown in Figure 4F. The main part of the tissue consisted of fibroblasts with elongated oval or spindle-shaped nuclei. Near the periosteum the fibrous tissue was more cellular than in the deeper portions. In most regions, the cortical bone had completely disappeared, but occasionally a few fragments of bone, usually surrounded by multinucleated cells, could be seen adjacent to the periosteum (Fig. 4G). No bone was found in the deeper tissues, and there was no evidence of cartilage, osteoid, or cysts in the fibrous mass. A few histiocytes were present, but there were no significant collections of acute or chronic inflammatory cells. No mitoses were seen. The diagnosis was fibrous dysplasia of the maxilla and mandible.

The wounds healed normally and the patient was discharged from the hospital on Dec. 9, 1949.

He was re-examined on April 22, 1950, at thirty-four months of age; the lower jaw had increased in size, and additional teeth had fallen out. At the

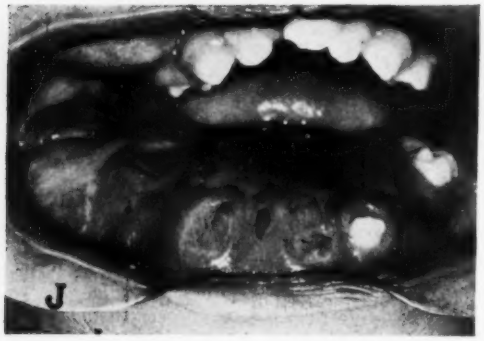

Fig. 4J. Case 4: Intraoral picture at thirty-four months. The alveolar ridges meet in the mid-line and the floor of the mouth is on a level with the crowns of the two remaining lower teeth. The tongue is displaced upward and posteriorly, where it interferes with respiration and speech.

symphysis, the vertical dimension of the mandible had increased greatly, and the chin was much more prominent (Fig. 4, H and I). The lower alveolar ridges had continued their expansion medially and had met in the mid-line beneath the mucosa. Consequently, the floor of the oral cavity had become a smooth surface on a level with the crowns of the two remaining lower teeth (Fig. 4J). The tongue was displaced so far upward and posteriorly that it caused noisy respiration. Its movement was so limited by lack of space that the patient's speech was unintelligible, even to his parents, although prior to the onset of the disorder he had talked plainly. The mouth and lips could not be closed because of malocclusion of the posterior parts of the alveolar arches and lack of space for the tongue. On attempts to eat, most of the candy-saliva mixture drooled onto the bib which he wore constantly. The submandibular lymph nodes had enlarged to a diameter of 2.5 cm. There were no other symptoms and the child remained well nourished. He was alert and cheerful at home but had apparently become self-conscious about his appearance and refused to play with other children. Roentgenograms revealed additional expansion and rarefaction of the anterior part of the mandible.

It was apparent that further expansion of the jaws would cause increasing respiratory obstruction and would necessitate some form of surgical intervention.

CASE 5: W. C., Negro, aged 33, father of Patient 4, stated that as a child his facial appearance had been similar to that of his son. His wife stated that when she first met the father, twelve years previously, his lower jaw was very prominent, but that his facial appearance had gradually improved.

The father was seen to have a prominent lower jaw, especially in the vertical dimension, but it was not disfiguring and would probably have passed unnoticed in the absence of the history (Fig. 5A). On

Fig. 5A. Case 5. Father of Patient 4, 33 years of age. Photograph showing a slight increase in the vertical dimension of the lower jaw.

palpation, however, the size of the mandible was found to be increased and the alveolar ridges were widened and irregular. Only six teeth remained in the lower jaw. Dentition in the upper jaw was normal, and there was no palpable overgrowth of the maxilla.

Roentgen examination revealed a massive mandible, the borders of which were irregular (Fig. 5B). The bony trabeculae were short and delicate; their number was increased to such an extent that the general appearance of the bone was that of a marked granular sclerosis. Near the angles of the jaw were a few areas of slightly diminished density, but no distinct loculations were visible.

The upper jaw was normal. The maxillary sinuses were well developed, and the margins of the maxilla were sharply defined. All the upper teeth were present and were normally spaced (Fig. 5C).

COMMENT

Clinical Features: Although this disorder appears to be of genetic origin, all patients were apparently normal at birth. The jaws of 2 patients were examined roentgenographically prior to the clinical onset of swellings, of Patient 4 during the first week of life, and of Jones' oldest patient "early in the second year of life." In both, the bones of the jaws were normal.

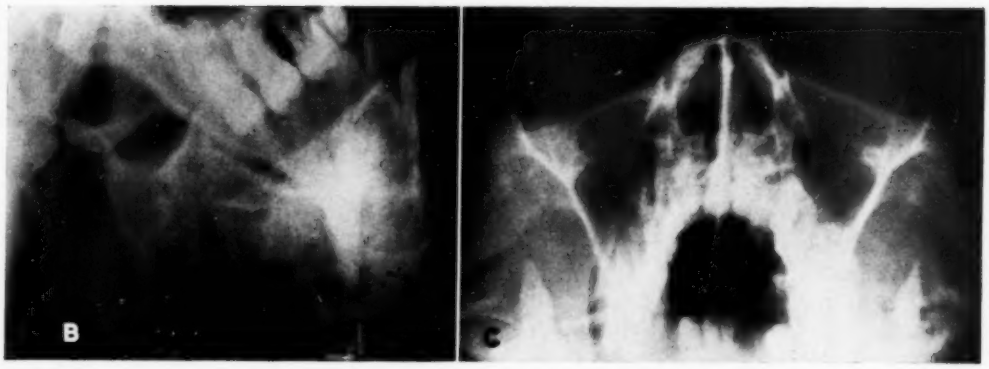

Fig. 5, B and C. Case 5. B. Oblique film of the mandible. The bone is markedly enlarged and shows a granular sclerosis; its edges are irregular. C. The maxilla is normal.

Neither patient exhibited enlargement of the cervical lymph nodes before the facial swellings appeared. In 5 of the 6 patients who were observed during early childhood (4, 14) the facial swelling first appeared between fourteen and thirty-six months of age, but in Patient 1, who was first seen at five and a half years, the mother noticed "enlarged jaws shortly after birth."

With slight individual variations, the facies were strikingly similar in all patients during childhood, at the peak of the disease. The lower half of the face was diffusely swollen. In some cases the enlargement was greater in the buccal regions (Fig. 1, A and B), and in other cases swelling of the lower jaw was greater (Fig. 4, H and I). In some, the skin of the face had a tightly stretched appearance, but in these patients the movements of the jaw were painless and there was no tenderness. In Patient 4 there was marked limitation of motion due to massive enlargement of the jaws and lack of space for the tongue; in the other children, movements of the jaw were free. Swelling of the cheeks stretched the skin and retracted the lower lids, which, in turn, exposed a band of white sclera between the iris and lower eyelid. This resulted in an "eyes raised to heaven" appearance, aptly described by Jones as "cherubism" (Fig. 6). The tongue did not protrude from the mouth but, in one patient, swelling of the alveolar process elevated the tongue and displaced it posteriorly. This interfered with closure of the mouth, made speech unintelligible, and finally caused a significant degree of respiratory obstruction. In all patients the lips were everted and thickened. The nose was not abnormal except for lateral spreading of the nostrils in some instances; this was due to stretching of the skin over the swollen upper maxilla. The open mouth, everted lips, and upward-rolled eyes combined to produce an empty, somewhat stupid facial appearance, similar in some respects to adenoid facies.

Fig. 6. Photograph of the patients described by Dr. W. A. Jones. (Reproduced from Am. J. Cancer **17**: 946, 1933.)

Dentition in the mandible was abnormal in all cases. The teeth were widely spread in the enlarged bone, some were imperfectly developed, some became loose and were lost early in life, and many never appeared. Dentition in the maxilla, in contrast, was

usually normal, even in cases in which the maxillary lesion was as marked as that of the mandible. There were no pathological fractures in these radiolucent fibrous jaws.

Marked enlargement of the submaxillary lymph nodes was present in 5 of the 6 patients observed during early childhood. In one of our patients, prominent hard swellings of the upper cervical nodes were evident on the first examination at twenty-eight months and in one at five and a half years of age. In one of Jones' patients, enlargement of the upper cervical nodes was not detected until two years after the appearance of facial swelling. According to Jones (5), regression of the enlarged nodes begins after three to five years; the cervical lymph nodes of our adult patients were not enlarged. In all cases lymphadenopathy has been limited to the submaxillary regions and in no case has there been softening or purulent discharge. It is possible that the nodal lesions are due to chronic inflammation secondary to either stasis of oral liquids in the swollen mouth or to sepsis around the teeth. Enlargement of the lymph nodes is not an essential component of this disorder, since there was no lymphadenopathy in the patient described by Thomas (14). In a section of an enlarged cervical node, Jones (4) found hypertrophy due to fibrous overgrowth with proliferation of the endothelial cells in the sinuses.

This disease has not been followed in a single patient during infancy, childhood, and adult life. It is probable that the jaws expand most rapidly during the first year or two after onset, and the most striking facial deformities are seen near the end of this period of rapid expansion. The disorder then advances slowly or remains stationary for approximately five years, and the facies, during this time, shows little or no change. Beginning at about the tenth year, there is a progressive improvement in facial appearance, especially in the buccal regions; and by puberty the improvement is so marked that an absolute decrease in the size of the expanded jaws might be suspected. Roentgenograms, however, show that this has not occurred; enlargement of the mandible persists. The maxilla also enlarges rapidly in the early phases of the disease, and it appears that the maxillary lesions regress much more rapidly than those in the mandible. After puberty, there is a progressive improvement in facial appearance, and by middle age the facies has usually returned to normal; neither of our adult patients, aged thirty-three and thirty-eight, showed a striking facial abnormality.

Except for defective dentition and mechanical difficulties caused by the enlarged jaw, there have been no symptoms or systemic manifestations associated with this disorder. All the patients have been afebrile, and the sedimentation rate and other blood findings have been normal. The values for serum calcium, phosphorus, and alkaline phosphatase have not been altered. All the children have been alert, active, and well developed. There have been no examples of localized cutaneous hyperpigmentation.

Familial Nature: In the first family (Cases 1, 2, and 3) the mother, a son, and a daughter had enlargement of the jaws, while jaws of the father and two sons, aged seven and sixteen, were normal. None of the father's ancestors was thought to have had this disorder; but on the maternal side the grandfather, an aunt, and an uncle were said to have had swollen jaws when they were children. In all the ancestors, the swellings had gradually disappeared with increase in age and the facial appearance had become normal. The ancestors were not examined by us.

In the second family (Cases 4 and 5), father and son showed this disorder, while the mother and two other sons, aged a year and a half and five years, were normal. The father denied the presence of a similar condition in any of his ancestors.

From the data available, it is not possible to determine the type of inheritance of this disease. In each generation of the four families (Jones, Thomas, Caffey and Williams), some of the siblings were normal. In three of the families the trait was pres-

ent in the progenitors of one parent; males were affected more frequently. In Jones' family, however, both parents were said to have normal jaws, but no mention is made of a roentgen examination and it is possible that the less conspicuous residual changes in the jaws of adults may have been missed without roentgen study.

Roentgen Findings: In the mandibles of these children there were numerous sharply defined multilocular areas of decreased density, and in many parts of the bone only a few opaque septa could be seen. In most portions there was marked expansion, and the cortex was reduced to a thin, irregular shell or was absent. The teeth were often ectopic, and many appeared to be suspended in tissue of water density.

It is evident from the patients described by Jones and Thomas that increasing destruction and expansion of the mandible may continue until puberty, but the major destructive changes occur during the first year or two after onset. Beginning at eight to twelve years of age, the bony septa increase in density, and minute calcified spicules are deposited in the cyst-like areas; this results in a ground-glass appearance in the roentgenogram. New cortical bone is laid down, and the margins of the mandible tend to become more nearly regular. During earlier stages, these reparative processes may occur in one area while expansion is appearing elsewhere. After puberty, however, new areas of rarefaction and expansion probably do not appear. With progressive calcification of the bone, its density returns to normal; and in adult life the multilocular rarefactions are either poorly defined or absent, and the entire mandible may appear sclerotic. The bony trabeculae in our adults were small, closely packed, very numerous, and without pattern.

It is of unusual interest that during childhood the facial appearance may improve while the mandible is still increasing in size. After puberty, however, there may be an absolute decrease in size of the lower jaw; this is clearly shown by Patient 3, age thirty-eight, in whom the mandible was of normal size despite marked swelling during childhood. Thomas, using models of the alveolar ridges, demonstrated a similar decrease in size of the lower jaw between the ages of fourteen and twenty-two years. In other cases the expanded lower jaw may show little or no change in size; Patient 5 had a massive mandible at age thirty-three, although his face was not conspicuously swollen.

The lesions in the maxilla and mandible differed strikingly. In the enlarged maxilla there was a diffuse even rarefaction, whereas in the mandible there was multilocular expansion. In neither of our infants was there any suggestion of multilocular rarefaction in the maxilla. The margins of the maxillary bone were ill-defined and only a few bony trabeculae were visible. The maxillary sinuses were reduced in size or obliterated.

We believe that lesions in the maxilla regress more rapidly than in the mandible and the maxillary sinuses become normally pneumatized; in our adult patients, the maxillary bones were normal and the sinuses were well aerated. It is possible, however, that the maxilla was never involved in the 3 patients whom we observed only during the late stages of the disease.

The extent of this disorder was quite variable, but, with the exception of the condylar processes, all parts of the mandible and maxilla were affected in at least one patient. The evidence suggests that the earliest involvement occurs near the angles of the mandible and in the coronoid processes, while the incisor region is affected later, if at all. The lesions have been approximately symmetrical in all the individuals studied, but according to family histories some of the ancestors have shown asymmetrical swelling of the face and jaws. In all infants the lesions have been extensive, but cases with minimal involvement and no expansion of the jaws might be expected.

Except for one example of coxa plana, roentgen findings in the remainder of the skeleton were normal in all patients.

Pathology: The sections showed fibrous tissue containing varying numbers of giant cells, and the histological picture was identical with that of fibrous dysplasia.

It is not within the scope of this paper to discuss the diseases of the jaws which have been called fibrous dysplasia, fibrous osteoma, osteofibroma, and ossifying fibroma. Most of the recent writers agree with Schlumberger (1946) that these diseases may be regarded as variants of fibrous dysplasia (10). Stout (1947) pointed out that the fibrous and granulomatous lesions of the jaws are difficult to interpret histologically (12). He stated that pure types are not common and that some areas of a microscopic section might be considered giant-cell tumor, whereas other areas would be classified as osteoma.

In spite of their similar histologic appearance, we believe that fibrous dysplasia and familial fibrous enlargement of the jaws should be considered separate entities because of the marked differences in their clinical and radiographic pictures.

Differential Diagnosis: The familial nature of this disease, its early onset, extensive involvement of one or both jaws, and self-limited course would appear to differentiate it from the other known lesions of the jaws. Even in the absence of a positive family history it is believed that the correct diagnosis could be made on the basis of clinical and roentgen findings, providing there is extensive bilateral involvement of the mandible or of both the mandible and maxilla. Unilateral or minimal involvement, however, would present decided difficulties in the differential diagnosis, especially in the absence of a positive family history. Although we have not seen a case of unilateral involvement, the histories in two of the families would indicate that it can occur.

The altered facial appearance would probably not be an aid to diagnosis, since it could easily be simulated by other diseases, *e.g.*, diffuse vascular tumors and infantile cortical hyperostoses.

The most common diseases in the jaws which might cause difficulty in the roentgen diagnosis are those of dental origin. Multiple dentigerous or follicular cysts are not uncommon and are occasionally familial (3, 13), but they do not cause generalized expansion of the mandible and maxilla. Since these cysts are related to the dental follicles, the coronoid processes should not be affected. In addition, extensive involvement of the jaws by such cysts does not appear to have been described in children under five years of age.

Adamantinomas usually occur in an older group and are rarely multiple. Robinson (9), in a review of 295 cases, found only 1 which involved both the mandible and maxilla, and in 222 cases only 3 were in patients under five years of age. Multiple tumors occurring in both sides of the mandible are somewhat more common, but no examples were found in the literature in which there were multilocular areas of decreased density throughout the greater portion of either the mandible or maxilla. It should be pointed out, however, that cases of fibrosis of the jaws with minimal or unilateral involvement could probably not be differentiated from a cystic adamantinoma by roentgen examination.

Reticulo-endotheliosis of the Hand-Schüller-Christian type may occur in both the mandible and maxilla of young children, but the areas of bone destruction tend to be poorly defined and usually occur first around the roots and margins of the teeth. Facial swelling and expansion of the bone are not prominent features. Goldin (2) has described a case with bone destruction in both sides of the mandible without evidence of disease in other bones, but it seems unlikely that massive involvement of the jaws would occur without signs of the disease elsewhere in the body.

Osteitis fibrosa cystica secondary to hyperparathyroidism might cause changes which could not be differentiated roentgenographically or histologically, but the differential diagnosis should not be difficult from a clinical and chemical standpoint. It is recognized that the earliest roentgen changes of hyperparathyroidism may be

found in the jaw, but extensive, honeycombing of the entire mandible would not be expected in the absence of skeletal involvement elsewhere (6).

The literature contains numerous examples of fibrous dysplasia or related diseases in the jaws of children which could not be differentiated roentgenographically or histologically from the late stages of familial fibrosis (1, 8, 15, 16). None of these cases, however, was familial or showed extensive symmetrical expansion of the jaws at three years of age. Fibrous dysplasia of the maxilla and base of the skull tends to form dense sclerotic bone; Sherman and Sternbergh (11) state: "We have seen no case of maxillary fibrous dysplasia as a cyst-like process." None of the cases of familial fibrosis has shown localized hyperpigmentation of the skin, involvement of any bone except the maxilla and mandible, or sclerosis of the jaws during the early stages of the disease. In view of their similar histologic appearances, it is possible that familial fibrosis is merely a variant of fibrous dysplasia. However, since the latter is not familial and since its clinical features are entirely different, it is believed that, at least for the present, familial fibrous swelling of the jaws should be considered a separate entity.

SUMMARY

Five cases of familial fibrous swelling of the jaws, occurring in members of two families, are reported. The disorder is characterized by massive swelling of the cheeks and jaws beginning during the first three years of life. Dentition is defective. There are no associated symptoms or systemic manifestations unless the lower jaw becomes so large that it prevents closure of the mouth and interferes with respiration and speech. Roentgenograms show extensive multilocular rarefaction and marked expansion of the mandible. The maxilla is also greatly expanded, but the rarefaction is diffuse and even rather than multilocular. No other bones are affected.

Beginning near puberty, there is an improvement in facial appearance, with a progressive decrease in the size of the jaws; by middle age the roentgen and facial abnormalities are minimal or absent.

Tissue specimens from the jaws show microscopic changes similar to those of fibrous dysplasia, but the clinical and roentgen features of these two diseases differ so markedly that they are considered separate entities. The differential diagnosis is discussed.

ADDENDUM: Since this paper was submitted, later observations on the patients first described by Jones in 1933 have been published, with an account of the results of surgical treatment in 3 cases (Jones, W.A., Gerrie, J., and Pritchard, J.: Cherubism—a Familial Fibrous Dysplasia of the Jaws. J. Bone & Joint Surg. **32**-B: 334, 1950). The spontaneous regression of the swellings and roentgen changes during and after puberty in untreated patients must be taken into account when the results of surgical procedures are evaluated in older persons.

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SUMARIO

Edema Fibroso Familiar de las Mandíbulas

Los 5 casos comunicados son de edema fibroso familiar de las mandíbulas, observado en miembros de dos familias. El trastorno se caracteriza por hinchazón masiva de la mejillas y mandíbulas que se inicia durante los primeros tres años de la vida. La dentición es defectuosa. No hay síntomas o manifestaciones orgánicas concurrentes a menos que la mandíbula inferior alcance tal tamaño que impida el cierre de la boca y afecte la respiración y el habla. Las radiografías mostraron extensa rarefacción multilocular y notable expansión de la quijada. El maxilar superior también se halla considerablemente expandido, pero la rarefacción es difusa y uniforme más bien que multilocular. No hay otros huesos afectados.

Al aproximarse la pubertad, comienza a mejorar el aspecto facial y disminuye gradualmente el tamaño de las mandíbulas. Hacia la mitad de la vida, las anomalías roentgenológicas y faciales o son mínimas o han desaparecido.

Los ejemplares histológicos de las mandíbulas revelan alteraciones microscópicas que semejan displasia fibrosa, pero las características clínicas y roentgenológicas de ambas enfermedades discrepan a tal punto que están consideradas como entidades distintas. Se discute el diagnóstico diferencial.

Developments in Cerebral Angiography with Rapid Serialized X-ray Exposures on Roll Film 9 1/2 Inches Wide[1]

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CEREBRAL ANGIOGRAPHY is becoming a common diagnostic procedure for three principal reasons: First, it is now recognized that disorders and malformations of the cerebral vascular system occur far more frequently than was generally believed. Second, angiography affords the best and, in most instances, the only means of demonstrating and localizing these abnormalities. Third, the improvements in the technic of injection of contrast media, and more especially the development of equipment for the automatic serialization of x-ray exposures, have made angiography a practical procedure. We have had very few indications for injecting the vertebral arteries which supply the posterior cerebral arteries and those in the posterior fossa, and for that reason this discussion will be confined to the technic and results of injection of the internal carotid arteries.

CONTRAST MEDIA

The choice of a contrast medium is limited to 35 or 50 per cent diodrast, 50 per cent neo-iopax, and 24 to 26 per cent thorotrast. Recently we have employed 30 per cent urokon in animals. In our experience there seems to be little preference between 35 and 50 per cent diodrast when used in amounts less than 10 c.c. per injection. Since 50 per cent diodrast offers very little superiority in the degree of opacity on the angiogram, the 35 per cent is the more desirable, as it should be slightly less irritating to the blood vessels. It offers the same advantage over 50 per cent neo-iopax. In our hands the injection of either diodrast or neo-iopax solutions has produced minor to moderately severe transient reactions of the convulsive type. Others (1, 2, 3) have reported more serious changes in the blood-brain barrier and even reactions resulting in transient hemiplegia.[2] These severe reactions have usually followed introduction of large amounts of these solutions and/or repeated injections.

Thorotrast has the advantage of being more radiopaque than diodrast (35 per cent) and is probably slightly less irritating to the cerebral vessels. Untoward reactions of the type just described may occur less frequently following its use. It possesses, however, two disadvantages. First, the thorium dioxide may be of sufficient radioactivity to be harmful, especially when injected into children with a long life expectancy. Second, it can produce a serious disfiguring fibrosis of the tissues in the neck (4) when extravasation occurs. This latter hazard becomes very important in percutaneous injections. In fact, for the closed injection we do not use thorotrast and strongly urge that it be employed only when the artery is exposed and the injection made directly into the vessel, to eliminate the possibility of forcing it into the surrounding tissues. Ekström and Lindgren (5) have reported other unfavorable reactions from the use of thorotrast.

Urokon, the newest preparation, is a 30 per cent iodinated solution. During its extensive use in intravenous urography, it has been noted that the patients have seldom experienced any discomfort in the arm or shoulder during the injection. This

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[1] From the Department of Radiology, Washington University School of Medicine, St. Louis, Mo. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

[2] Since the presentation of this paper, Broman and co-workers have reported additional studies which suggest that a summation effect may be responsible for unfavorable reactions if the interval between injections of contrast medium is short (Broman, T., Forssman, B., and Olsson, O.: Further Experimental Investigations of Injuries from Contrast Media in Cerebral Angiography. Acta radiol. **34**: 135–143, July-August, 1950).

made us believe that it might be less irritating to the cerebral vessels than diodrast or neo-iopax and might be used advantageously in cerebral angiography. We have used it successfully on dogs and are preparing to go ahead with further investigations on appropriate patients.

The tests at present available for the detection of hypersensitivity to iodine compounds are not satisfactory, since all of the deaths collected by Dotter (16) occurred after negative tests. Pendergrass (6), however, recommends that they be employed for medicolegal reasons. We believe that the ideal contrast medium is yet to be found and that a strong effort should be directed toward minimizing the hazard incurred in the use of presently available material by developing equipment that will avoid the necessity of repeated injections of large amounts of an opaque contrast substance.

METHOD OF INJECTION

The technic of injection depends largely on the preference of the neurological surgeon and on the particular case at hand. In general, there has been a tendency to utilize the percutaneous method, in which the common carotid artery is entered through the intact skin, rather than the open method, in which the artery is exposed in the neck. At present about 50 per cent of our injections are done percutaneously. A No. 17 or 18 needle is used, and the medium is introduced very quickly without occlusion of the common carotid artery proximal to the site of injection or of the external carotid. We have not used a mechanized syringe as developed by Morgan (7) for intravenous cardiovascular angiography to expedite the injection or for the protection of the operator from scattered radiation, though the mechanical features may be of value in an effort to obtain smooth swift emptying of the syringe. Uniform pressure should be employed to avoid an interrupted injection with incomplete filling of the arterial tree, which can lead to errors in the interpretation of the angiograms.

The main sources of failure to obtain satisfactory arteriograms with automatic serial radiographic equipment are: (1) "missing" the artery with the needle and injection of the chemical into the soft tissues; (2) making a slow injection, with resulting dilution of the opaque chemical; (3) varying or interrupting the pressure on the plunger of the syringe, thus producing an intermittent filling of the arterial tree. It is therefore wise, whenever possible, to develop a regular "team" for doing cerebral angiography in order that one group can become proficient from repeated experience in avoiding as many "pitfalls" as possible.

The amount of contrast medium to be injected should be reduced to the minimum that will fill the arterial tree only momentarily. By rapid serialized x-ray exposures, it is possible to picture on a series of films the small "bolus" of opaque chemical as it fills and passes through the arterial tree and into the capillary bed. This is a new concept, as effort was formerly directed toward maintaining arterial filling sufficiently long to make conventional stereoscopic films. This required a greater quantity of the opaque medium, usually 15 to 30 c.c. This is a large amount to be repeated or to be accidentally injected into the soft tissues of the neck if the artery is missed. One hesitates to make a second or third injection under such circumstances. By our method, only 5 to 7 c.c. are used, and if, by accident, extravasation occurs, the injection can be repeated two or three times without exceeding the quantity formerly employed. This feature alone has made the percutaneous approach more attractive.

AUTOMATIC MECHANIZED RADIOGRAPHIC EQUIPMENT

Perhaps the most important recent advance in the technic of cerebral angiography has been the mechanization and automatization of radiographic equipment for the continuous serialization of x-ray exposures. Egas Moniz (8), who introduced cerebral angiography in 1927, was among the first to appreciate the advantages of a rapid

serialization by using the *radiocarrousel* (9). Later he made the first compact cassette changer, the *appareil escamoteur* (10). One of his early associates, Sanchez-Perez (11), in 1943 devised a manually operated cassette changer, the "cranial seriograph," which he later motorized and automatized in 1948 (12). At about the same time Scott and Moore (13) had constructed the tautograph, which exposed standard (11 × 14 in.) cassettes on a chain conveyor mechanism at the rate of one per second. It was the first of the cassette changers to operate with a synchronized self-cocking Potter-Bucky grid and provided films of greater clarity and detail.

All of the units devised for the rapid changing of cassettes have in common several disadvantages, varying in degree with the individual design. These include excessive noise and vibration, unwieldiness due to size, a lack of easy mobility, and an inadaptability to existing radiographic equipment. Of even more importance is the fact that very few are suitable for manufacturing on a commercial scale. Furthermore, a faster rate of exposure is desirable than can be attained by most of them.

With this experience, and in an effort to overcome these problems, Scott began thinking in terms of large-size x-ray roll film such as had been utilized by Jarre (14) in the Cin-ex Camera constructed by him in 1928. While serving at the Seattle Naval Hospital, Scott conceived the idea of adapting the Fairchild Aerial Camera to this purpose. In January 1948, he went to New York to discuss these problems with Mr. C. E. Seibert of the Fairchild company, who generously supplied a war-surplus A-5 magazine on which to start work.

Many interesting problems were presented. For instance, x-ray film is double-coated and has a stiff cellulose base to prevent curling. The magazine was designed to handle pliable photographic film which was flattened and immobilized during an exposure by an air-suction system. Not only was the x-ray film too stiff to be affected by this vacuum system, but for our purpose the film had to be exposed between two intensifying screens. Since we were dealing with x-rays, the film on the take-up and supply spools beneath the top of the magazine had to be protected by spraying the back of the steel plate holding the lower intensifying screen with lead to absorb these rays.

The magazine was originally powered through a coupling disk on the top surface, but for radiographic purposes it was necessary to place the Potter-Bucky grid as close to the top of the magazine as possible. Consequently, a new drive shaft gear had to be constructed on the front of the magazine in order to connect it to the motor. This gear had to mesh with the winding gear assembly to which we fitted a special cam. This cam raised the pressure plate-actuating lever assembly, which pushed the back vacuum plate and intensifying screen up against the film and the front intensifying screen to flatten the film and maintain it in firm contact with them during the exposure. The spindle for the winding gear shaft assembly was lengthened to project through the template, and a timing lever was secured to it for actuating a micro switch which in turn energized the Potter-Bucky grid.

A Bodine speed reducer motor of 1,725 r.p.m., 1/15 horsepower, and with a reduction ratio of 20 to 1, was bolted underneath the radiographic table and connected to the magazine by a transmission shaft and universal joint in such a manner that the magazine could be easily removed and taken to the darkroom for loading and unloading. To obtain the greatest possible clarity and contrast on the films, the magazine and the x-ray exposure were synchronized with a Liebel-Flarsheim self-cocking Potter-Bucky grid, which had been speeded up by Mr. Eugene Stober of that company. The entire equipment was fully integrated and automatized so that one technician could press the conventional exposure switch and it would make continuous x-ray exposures until it was released. Thus, for the first time, it was possible to make a

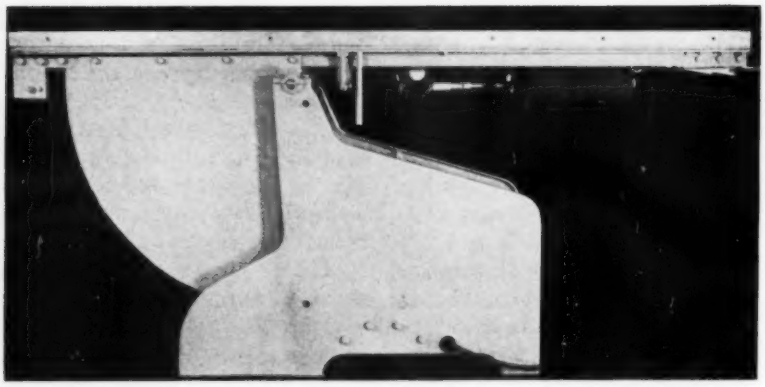

Fig. 1. The original magazine, as adapted for x-ray roll film 9 1/2 inches wide, was mounted beneath the top of a tilting x-ray table so that it could be removed from the end of the table and taken to the darkroom for loading and unloading.

A Bodine speed reducer motor was bolted to the under surface of the table and connected to the drive-shaft gear on the magazine by a transmission shaft and universal joint.

A self-cocking high-speed Liebel-Flarsheim grid was inserted into the top of the table just above the top of the magazine. At the moment the film was rolled into place and stopped, a microswitch operating on the drive shaft put the Bucky grid in motion, the grid in turn energized the x-ray exposure. The equipment was all integrated so that, when the x-ray technician closed the exposure switch, a continuous series of exposures was made on the roll film at the rate of 2 per second as long as the exposure switch remained closed.

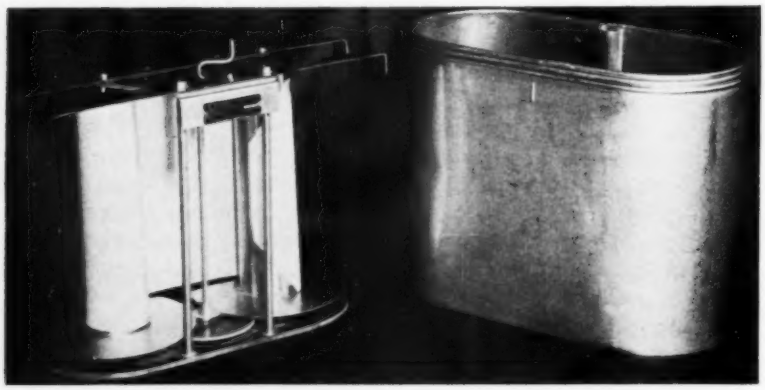

Fig. 2. Smith automatic film developing outfit. The exposed film from the magazine is first wound onto the supply spool shown on the left and the free end carried to the take-up spool on the right. The spools and supporting equipment are then placed in the developing tank and the film is wound from one roll and then the other for the required time. This is accomplished by turning the crank at the top of the winding assembly either by hand or by an electric motor.

The spools and winding mechanism are transferred to a fixing solution in the middle tank and later into a third tank filled with "hypo."

If conventional 10-gallon solution tanks are available, steel crossbars may be secured to the top of the winding mechanism which will reach across these tanks to support them. In this case it is not necessary to order the three nesting stainless steel tanks.

This developing outfit may be obtained from x-ray dealers or the Fairchild Camera and Instrument Corporation.

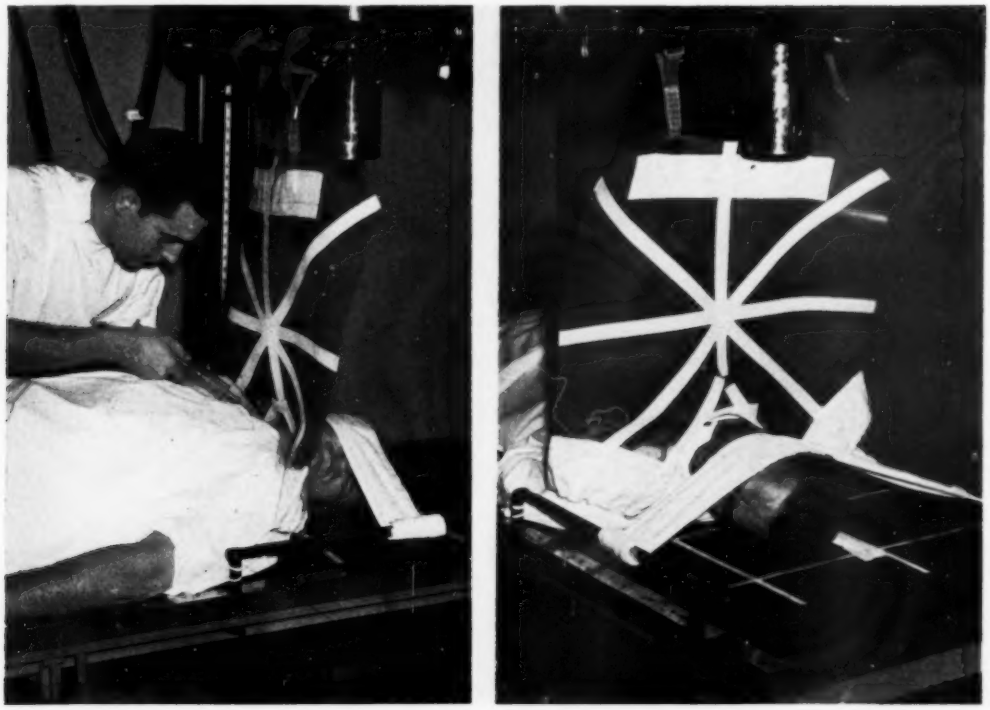

Fig. 3. Position of patient and technic of injection for percutaneous method.
The patient is placed in the supine position with the head turned toward the side to be injected (uppermost side). The head is immobilized by a tight linen binder and is carefully centered within the limits of the film as indicated by strips of adhesive tape placed on the bakelite top over the Potter-Bucky grid.
The physician making the injection is protected from scattered radiation by a sheet of lead rubber placed between him and the direct beam. The lead rubber sheet is suspended from the x-ray tube carriage and is fitted about the neck of the patient. The physician is also instructed to wear a lead rubber apron.
The smallest possible radiographic cone should be used to gain maximum clarity and to reduce the spray of radiation.

series of high-speed x-ray exposures of 1/20th of a second, at the rate of two every second, with an efficient Potter-Bucky grid operating continuously with safety, up to 30 exposures, all accomplished with a minimum of noise and vibration.

Furthermore, two other important objectives had been fulfilled. First, a small compact unit had been produced that could be adapted to existing radiographic tables, skull or sinus stands, hydraulic Potter-Bucky grid supports, or even incorporated into a small separate table. Secondly, much existing equipment had been utilized to expedite the problems of manufacture and to minimize the cost, which also explains the size of the magazine and film employed.

This unit is shown in Figure 1 and is described and illustrated in greater detail in an earlier paper (15). Scott and Moore named it the "rapidograph" and, having demonstrated it at the Thirty-fourth Annual Meeting of the Radiological Society of North America in December 1948, turned their ideas over to the Fairchild Camera and Instrument Corporation, who brought out the factory model called the "roll-film cassette." It is equipped with a wafer grid which is kept in motion by the original coupling disk on the top of the magazine. This "shaker" grid was first tried by us in our department and, while it may be an improvement over the stationary grid, it does not have the efficiency of the self-cocking Liebel-Flarsheim grid,

which we recommend and which we have continued to use.

The strips of film are processed by placing them in a conventional five-gallon developing tank and moving the film about by hand for the required time. They are then rinsed, dropped in the "hypo" tanks for clearing, transferred to the wash tanks, and hung up to dry by securing one end to a rod on the ceiling. Smith automatic film developing outfits (Fig. 2) are available for processing long strips of film and can be modified to conform with existing darkroom equipment so that holder and spools can be inserted in the 10-gallon solution tanks without using the special tanks.

Since the rapidograph covers an area of 9 1/2 × 9 1/2 inches, it is necessary that the patient be carefully positioned if one is to obtain the entire skull on the film. As a check on the position and on the exposure factors, we insert a metal tray containing a 10 × 12-inch cassette in the position of the magazine under the table and expose it. The film is immediately developed and examined to determine if any adjustments, are required before the injection is started.

TECHNIC OF INJECTION AND EXAMINATION

From experience we have learned that lateral stereoscopic films and anteroposterior views are essential for the accurate and complete visualization of the cerebral arterial system, and every effort is made to obtain them in every case. The examination is begun with the patient supine on the radiographic table with the head turned in the lateral position, with the side to be injected uppermost (Fig. 3). The head is securely immobilized in this position by a tight linen binder. The x-ray tube is placed in the first stereoscopic position. As soon as the needle has been securely inserted in the common carotid artery and fitted to a Luer-Lok syringe containing 35 per cent diodrast, the rapidograph is started. After making one exposure, 5 c.c. of the opaque chemical is injected as quickly as possible. The rapidograph remains in continuous operation during the injection and for eight exposures before it is stopped. The x-ray tube is shifted to the second stereoscopic position, the rapidograph started, a second injection of 5 c.c. is made, and eight more exposures are taken before it is stopped. The x-ray tube is then centered, the patient's head is released and carefully rotated into the anteroposterior position and again secured. The rapidograph is started again, a third 5 c.c. is injected, and the last series of eight films is made. It is difficult to count the exact number of exposures, as they occur very rapidly. In order to overcome this difficulty, and also to have the advantage of spacing the exposures, sequencing devices have been made by several manufacturers.[3] These are desirable and give the radiologist better control over these "rapid-firing" units. The conventional impulse timers are satisfactory if the exposures are slower than two per second. Beyond this speed, thyrotron electronic impulse timers are necessary and are now available alone or in combination with sequencing devices. In new installations these accessories should be obtained, for they will accomplish all that the present timers can do and, in addition, are necessary for fast-operating roll-film units or cassette changers.

In a further effort to reduce the number of injections and to decrease the hazard of cerebral angiography, two of these roll-film units were placed at right angles to each other. In this way the anteroposterior and lateral views could be made simultaneously during and after a single injection. Equipment of this type was shown at the 1949 meeting of the American Roentgen Ray Society by Morgan (7) for cardiovascular angiography. The unit we first developed is shown in Figures 4 and 5 and consists of two Fairchild roll-film cassettes secured to heavy boiler plate, the whole being mounted on an adjustable hydraulic base. It is equipped with high-speed self-cocking Liebel-Flarsheim Potter-Bucky grids similar to that utilized on the original rapidograph. This "double rapidograph"

[3] Westinghouse Electric Corp., Fairchild Camera and Instrument Corp., Franklin X-Ray Corp., F-R Machine Works, and probably others.

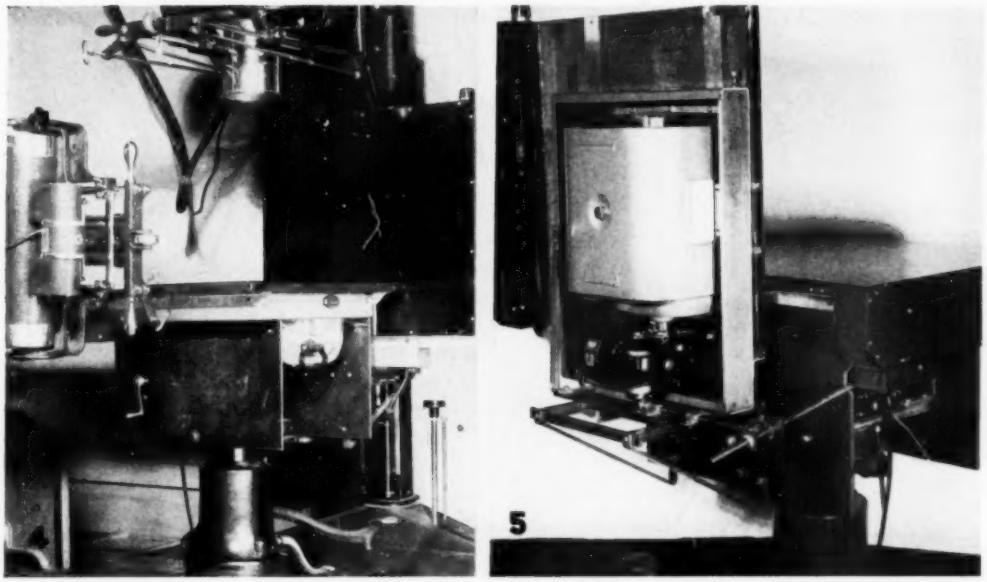

Fig. 4. Double rapidograph in which two roll-film cassettes have been placed at right angles to each other to permit the simultaneous recording of lateral and anteroposterior angiograms during and following a single injection of opaque material.

The magazines were mounted on a frame of heavy boiler plate and set on an adjustable hydraulic stand. High-speed self-cocking Bucky grids were placed over the magazines and synchronized with them and the x-ray exposure.

Fig. 5. Rear view of double unit to illustrate the method of mounting the magazines and the system of Boston gears which was necessary to keep the two units operating in complete synchronization.

can be tilted 45° toward the feet for the anteroposterior position. Furthermore, the vertical rapidograph can be moved laterally enough to permit cardiovascular as well as cerebral angiography.

The operation of this double unit requires two rotating anode tubes, two 300- or 500-ma. transformers, two impulse timers or thyrotron electronic timers, and a positive mechanical connection between the two motors on the magazines through a system of Boston gears and a telescopic drive shaft. X-ray exposures are made at alternate half seconds to avoid an overload on the contacts in the single control panel and on the electrical lines. This may be an over-elaboration for minimizing the risks in cerebral angiography, but we feel it is worth exploration.[4] Actually the development of an innocuous opaque medium that would permit repeated injections would furnish a simpler means of solving these problems.

ADVANTAGES OF SERIAL ANGIOGRAMS

The following advantages are offered by serial films in cerebral angiography: (1) demonstration of the progressive filling of the arterial tree; (2) a definite assurance that the arterial tree will be visualized at its maximum filling; (3) a means of confirming the constancy of a filling defect by comparing a particular film with those taken immediately before or after; (4) elimination of the delay of unloading and of loading cassettes between injections if stereoscopic films are desired and when the anteroposterior examination follows the lateral view; (5) reduction of noise and vibration to a minimum; (6) the possibility of repeating immediately injections interrupted by a faulty syringe or by movement of the patient, since sufficient film is avail-

[4] Since the presentation of this paper at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Dec. 4–9, 1949, this double unit has been revamped and simplified in many aspects, largely to provide greater stability and to bring the vertical magazine in closer apposition to the patient's head.

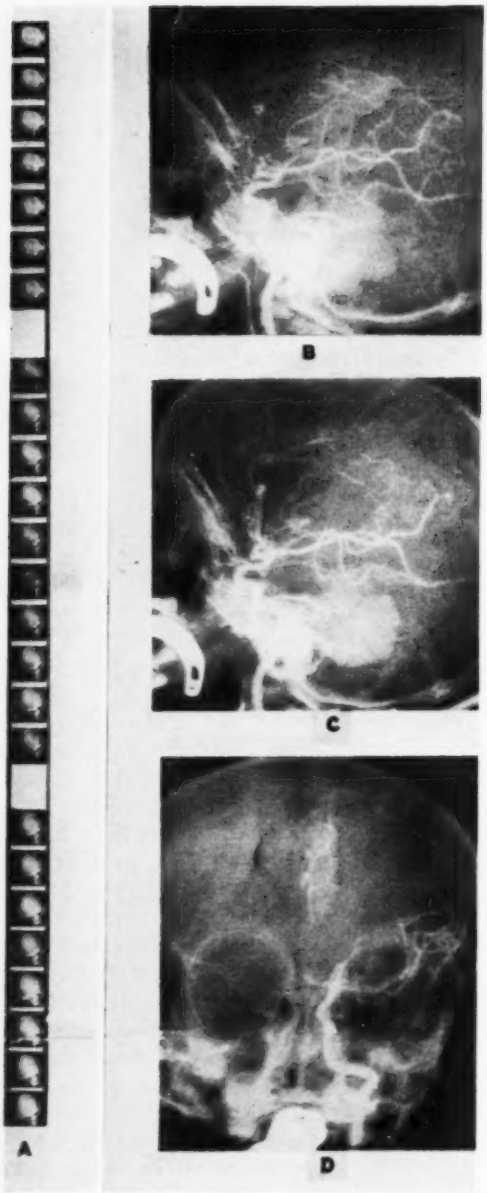

Fig. 6. Routine series of films obtained by cerebral angiography, including first and second series of exposures for stereoscopic study and the anteroposterior series.

A. Normal cerebro-angiographic examination with continuous series of exposures made on roll film 9 1/2 inches wide, at the rate of two per second. An injection of 4 c.c. of diodrast (35%) was made after the first exposure in each group, to a total of 12 c.c. From the bottom up: first stereoscopic position; second stereoscopic position; anteroposterior position.

B. Exposure No. 3 of the first stereoscopic series in the lateral position.

C. Exposure No. 4 of the second stereoscopic series in the lateral position, which matches No. 3 of the first series. These two films are cut out of the roll and placed in the stereoscope for study.

D. Exposure No. 4 in the anteroposterior series.

able on the supply roll without waiting for the exposed cassettes to be reloaded. Finally, the positive action of the roll-film units has fulfilled the radiologist's responsibility to obtain satisfactory cerebral angiograms.

The accompanying figures illustrate many of these and similar points which we have learned by experience in doing cerebral angiography with the rapid roll-film technic. Figure 6 is a normal cerebral angiogram obtained on a two and a half-year-old colored girl with a history of a convulsive disorder of one year duration. The exposed roll of film, 9 1/2 inches wide and 23 feet in length, is shown in A, with an unexposed space between the first and second set of a series of lateral stereoscopic exposures and again between the second lateral stereoscopic series and the anteroposterior series. The individual exposures that show the same distribution of radiopaque material in the arterial tree are paired up for stereoscopic viewing. The films in B and C constitute such a pair.

Figure 7 illustrates the great value of having a series of continuous exposures to cover the entire time required for the filling of the cerebral arterial tree, the capillary phase, and the venous system. Adequate films should be made of all three phases. In this fifty-one year-old male, exposure No. 4 (B) demonstrates only the aneurysm in the *right* anterior cerebral artery near its origin. If only one exposure had been made at this moment, the diagnosis of the arteriovenous aneurysm and angiomatous collection of vessels in the posterior portion of the *left* parietal lobe demonstrated on exposure No. 6 (C) would have been missed. Only a single injection of 7 c.c. was made in the right internal carotid artery of 35 per cent diodrast, but some of the opaque chemical had passed through the anterior communicating artery to the

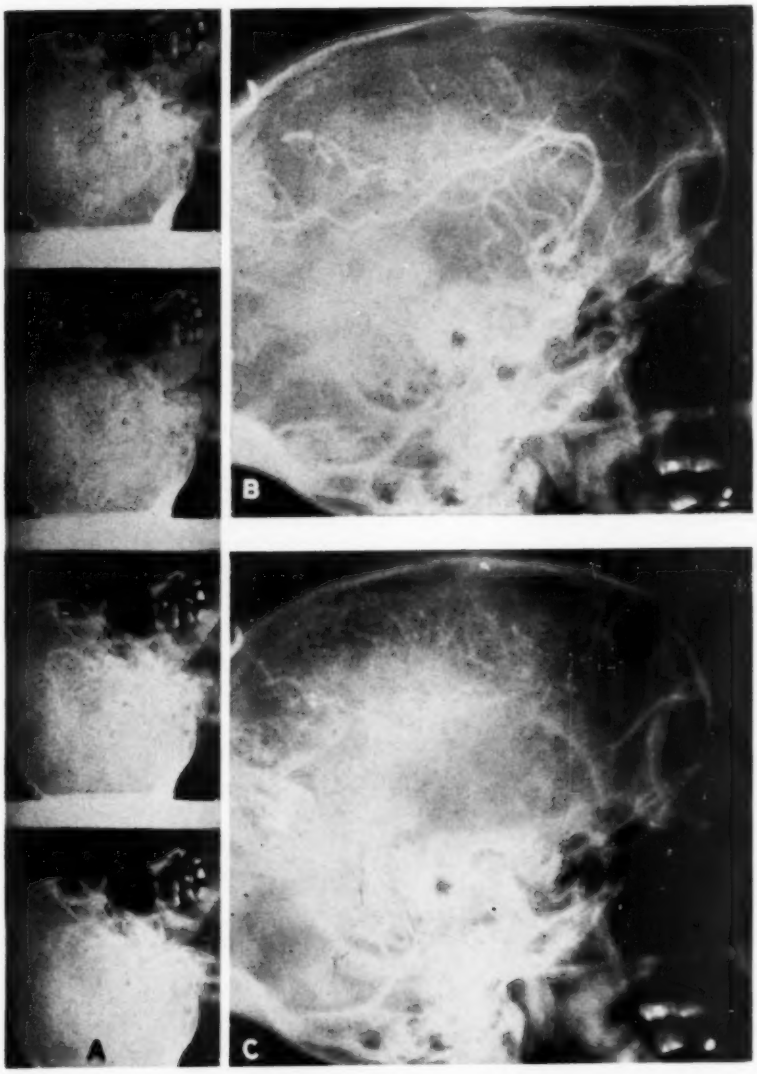

Fig. 7. Section of angiographic series demonstrating (1) the advantages of having a complete record of the filling and emptying of the cerebral arterial tree; (2) lateral stereoscopic films; (3) the importance of the anteroposterior view. A single exposure, as No. 3 or No. 4, would show only the aneurysm of the *right* anterior cerebral artery, as seen in B, while No. 6 alone would portray only the arteriovenous mass of vessels in the *left* and posterior part of the parietal lobe (C).

A. A single series of radiographic exposures in only the lateral view is entirely inadequate because it is impossible to determine if the aneurysm at the base of the anterior cerebral artery is on the left or right, and the same is true of the angiomatous collection of vessels in the posterior portion of the parietal lobe.

B. Aneurysm near the base of the right anterior cerebral artery. Note that the anterior cerebral arteries are filled on both sides.

C. Arteriovenous aneurysm in the posterior portion of the left parietal lobe, filled by the radiopaque chemical passing through the anterior connecting arteries and the middle cerebral arteries.

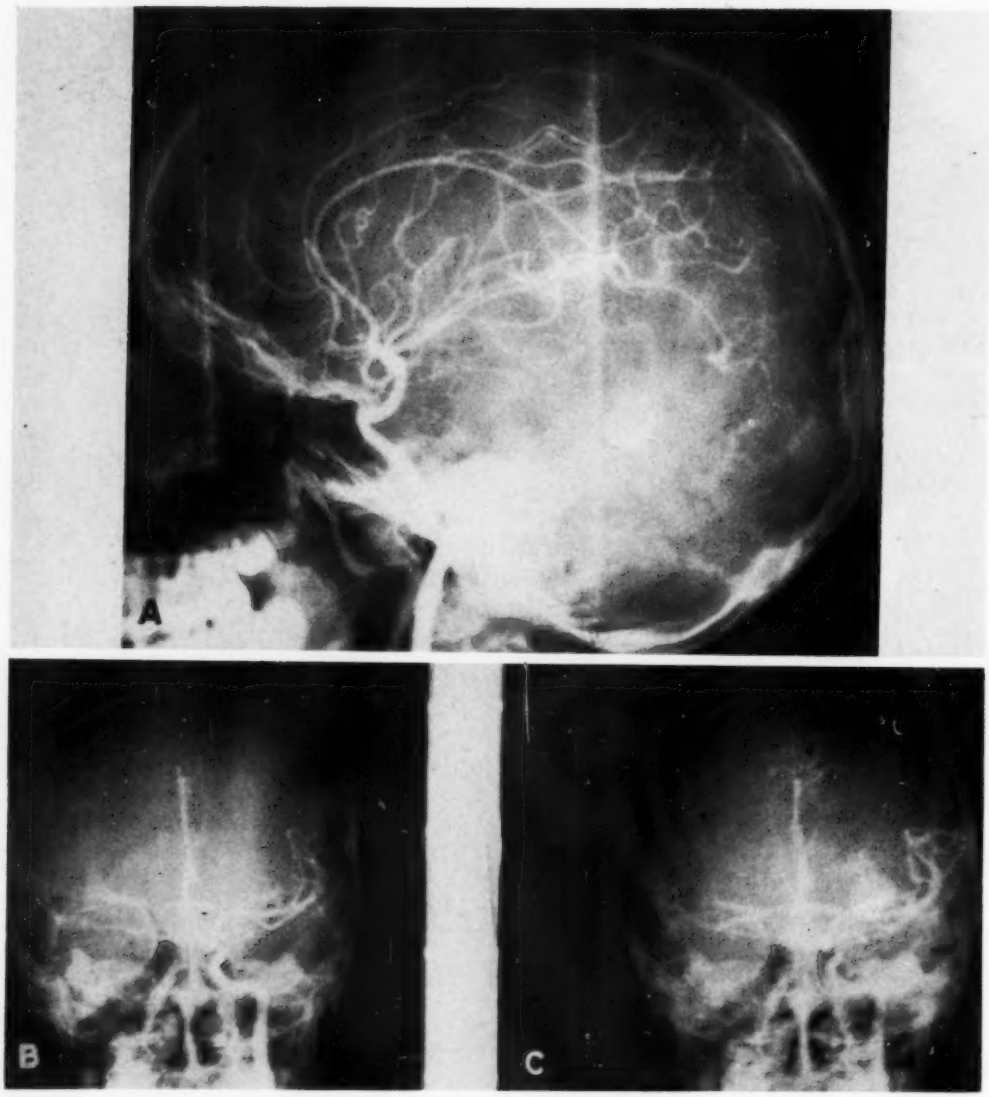

Fig. 8. Illustrating the vagaries in the distribution of the contrast medium recorded at different injections and at different times following the same injection.

The same quantity of medium was used for all injections, which required about the same length of time and pressure. These variations in the distribution of the opaque medium can be caught only by the use of serial exposures, which increases the accuracy of interpretation of cerebral angiograms.

A. No. 4 in the first series of lateral stereoscopic cerebral angiograms in which only the left anterior cerebral artery is filled, with upward and forward displacement of the internal carotid siphon by a craniopharyngioma which was differentiated from a large aneurysm by this examination.

B. No. 6 of the anteroposterior series. At the moment only the left anterior and middle cerebral arteries are filled.

C. No. 7 of the anteroposterior series (1/2 second later). The opaque chemical has passed from the left anterior cerebral artery through the anterior communicating artery into the right anterior and right middle cerebral arteries.

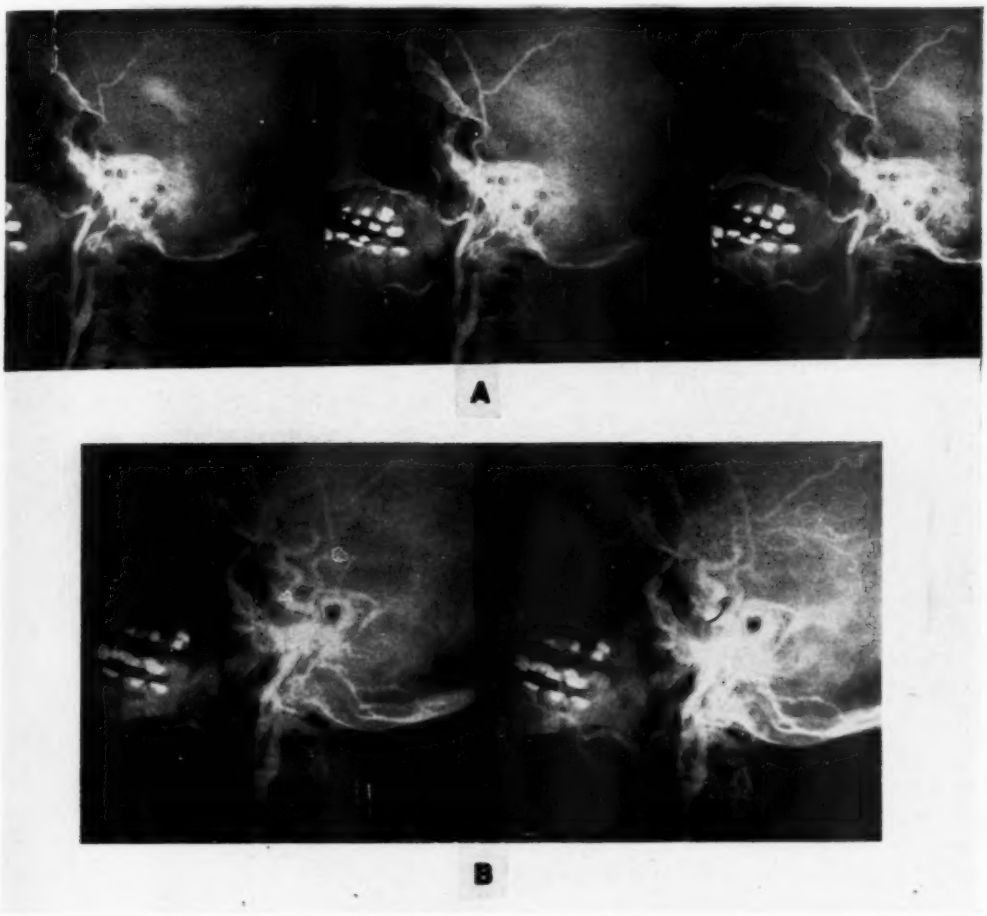

Fig. 9. Slight changes in the direction in which the needle is pointed or the place and manner in which it is inserted in the common carotid artery can influence the way in which the external and internal carotid arteries are filled.

A. First stereoscopic series of films after injection of 7 c.c. of diodrast into the right common carotid artery. There is apparent occlusion of the internal common carotid at a point a few centimeters distal to the bifurcation, appearing as a constant finding on three successive films.

B. With the second injection made a few minutes later, and with no marked difference in the position of the needle, both the external and internal carotid arteries are well filled. This rules out the possibility of an occlusion of the internal cerebral artery. This emphasizes the importance of considering only constant filling defects as being of clinical significance and also the fact that in cerebral angiography you are dealing with a very rapidly moving contrast medium that flows through the arteries even faster than normal because the opaque chemical is injected quickly by strong pressure applied against the plunger of the syringe to achieve quick filling of the vessel.

left anterior cerebral artery and on back to the left middle cerebral artery.

Figure 8 depicts an excellent filling of the left cerebral arterial tree with upward and forward displacement of the carotid siphon by a large craniopharyngioma which was differentiated from an aneurysm by this examination. In the lateral series and in exposure No. 6 of the anteroposterior series (B) only the left anterior and left middle cerebral arteries are filled. One-half second later in No. 7 of the anteroposterior series (C) the contrast medium has passed through the anterior communicating artery to fill the right anterior cerebral artery and even back into the right middle cerebral artery. Thus, the right and left cerebral arterial trees can be visualized from a single

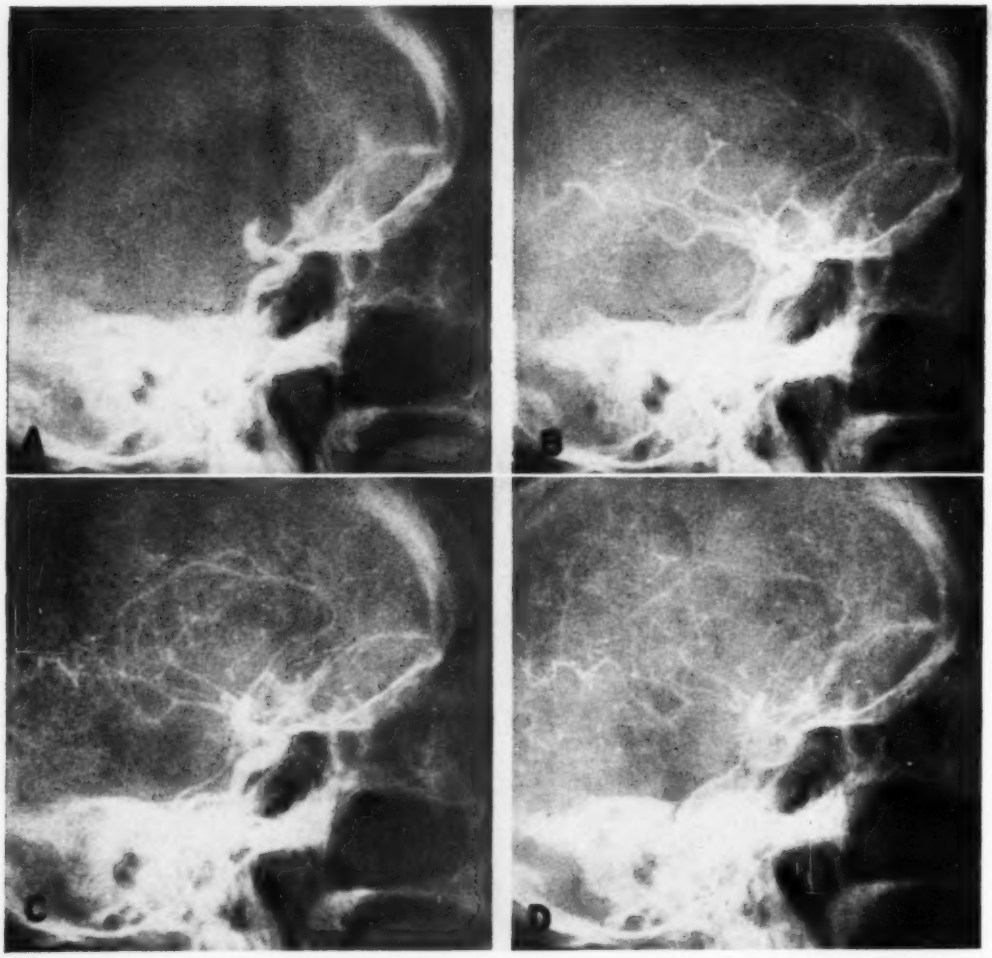

Fig. 10. Rapid serialization of radiographic exposures is the only means by which a defect can be demonstrated as being constant, in dealing with fast-moving contrast media in arterial vessels.

The interpreter of the above four serial films can report a partial occlusion at the base of the middle cerebral artery with far more confidence when he has the four exposures such as the above instead of having to rely on just one of the four.

injection of 6 c.c. into the left internal carotid artery. This type of transfer of the opaque medium from one side to the other occurs commonly and explains the necessity for taking stereoscopic films as well as anteroposterior views, not only for the accurate delineation of a vascular lesion in two views but to avoid errors that can be induced by the filling of the vessels on the opposite side.

In Figure 9 are the angiograms made on a thirty-year-old white male who experienced a sudden loss of consciousness six weeks prior to the angiographic examination. This loss of consciousness was followed by a right hemiplegia, during which the patient was semicomatose and aphasic for ten days. He was immediately hospitalized. A spinal tap yielded bloody spinal fluid. He was kept at rest in bed, throughout which time he complained of severe persistent headaches.

On the first lateral stereoscopic series of the angiographic examination, the ex-

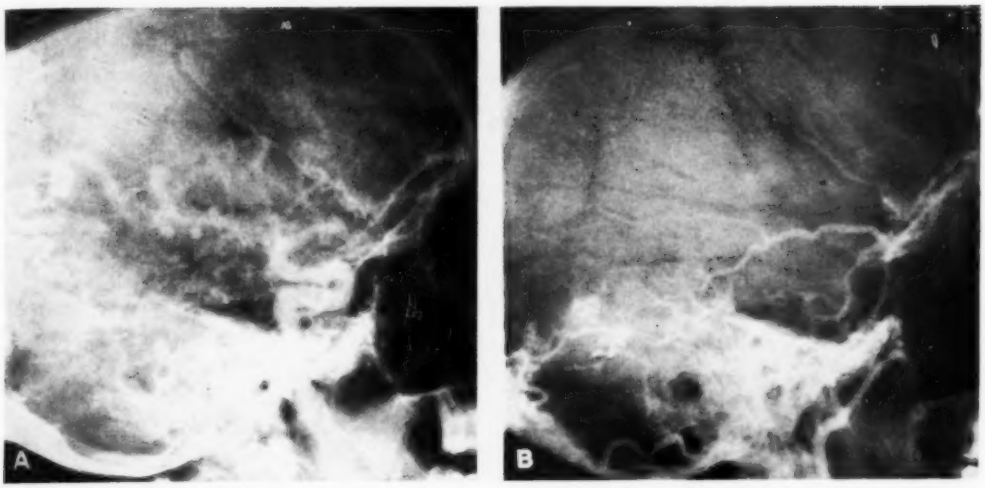

Fig. 11. In certain cases it is desirable to fill the internal carotid artery and the external carotid artery separately to determine the degree and extent of anastomosis that may take place between these two vessels, as in an arteriovenous angiomatous mass of vessels as illustrated above. The isolated filling of either one or the other would not have provided a complete picture of the ramifications of the cerebral circulation in this particular instance.

A. No. 1 of the first lateral stereoscopic series after the injection of the internal carotid artery, delineating a large and widespread angiomatous malformation of cerebral vessels with arteriovenous connections.

The injection of the 7 c.c. of 70 per cent diodrast was accidentally given prematurely and, if the magazine had not been in operation to take a preliminary exposure, this key film would have been missed.

B. No. 16 in the total series of lateral views (No. 6 in the second stereoscopic series) depicts the filling of the external carotid artery and its communications through the skull, with the angiomatous collection of vessels demonstrated above by the injection of the internal carotid artery.

ternal carotid artery and branches are well filled, but the internal carotid artery appears to be occluded at a point about 3 cm. distal to its origin. The second injection of an equal amount of diodrast (7 c.c. of 35 per cent) for the second stereoscopic series resulted in excellent filling of both the external and internal carotid arteries. No known change was made in the position of the patient's head, in the direction of the needle, or in the amount of pressure applied to the plunger of the syringe. The value and convenience of having a second set of stereoscopic films are thus readily appreciated. If only the first series of films were viewed, the examiner might be led to the erroneous opinion that the internal carotid artery was occluded since this apparent defect was demonstrated on three successive films.

Figure 10 is a set of four successive angiograms made at half-second intervals on a sixty-six-year-old white housewife. For the past six months she had suffered a gradual progressive mental deterioration. She was not coherent and was disoriented. She was emotionally unstable. Examination of the spinal fluid revealed it to be within normal limits. A ventriculographic examination was performed on two occasions without abnormal findings.

Several weeks after the air studies, an angiographic examination was done, which demonstrated an aneurysmal dilatation at the base of the middle cerebral artery due to arteriosclerotic changes and possibly with partial thrombosis. Certainly, the radiologist examining these four films could express greater confidence in his interpretation than if he were limited to any one of them.

Figure 11 is an angiographic study on a twenty-eight-year-old white veteran of World War II, who for many years had been aware of a continuous buzzing noise in his head which coincided with his pulse. In 1948, the noise became louder and developed into a roaring sensation. This

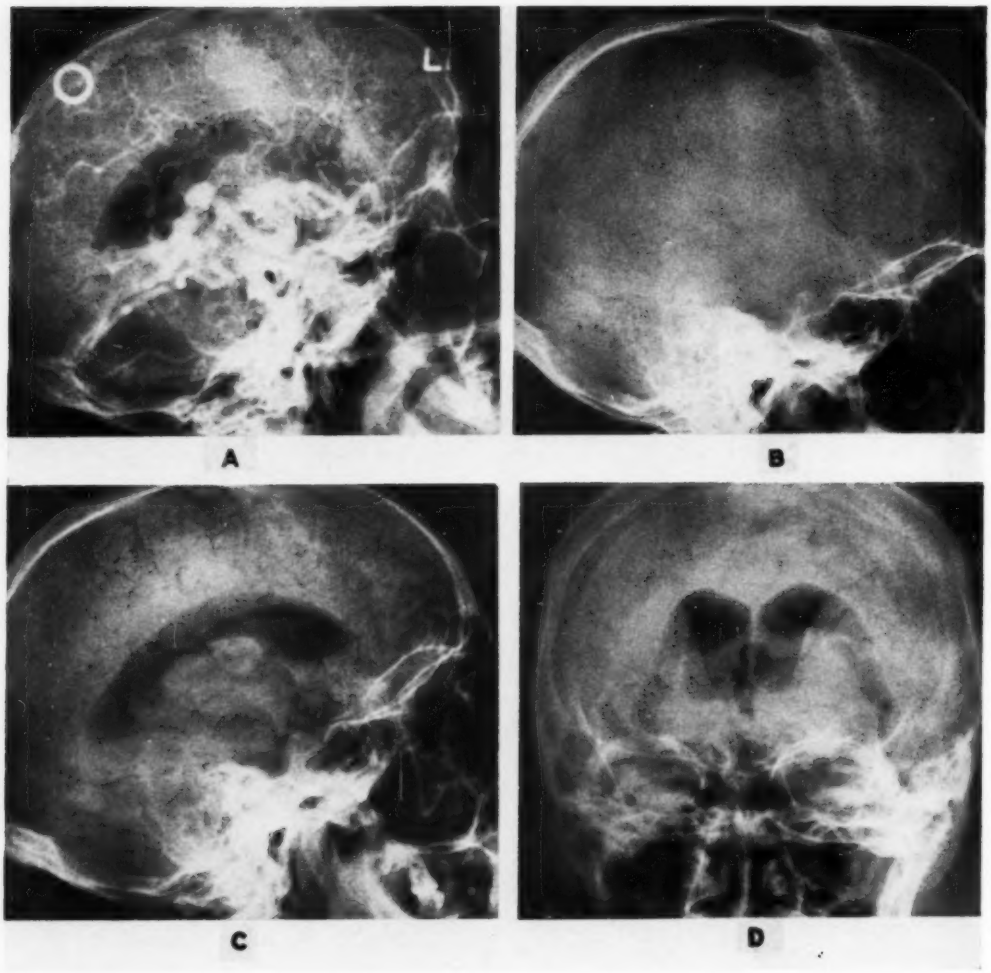

Fig. 12. An extensive collection of angiomatous malformed cerebral vessels with arterial venous anastomosis demonstrated after the injection of 7 c.c. of 75 per cent diodrast into the left internal carotid artery. It is important to realize that the only radiographic method by which this huge mass of vessels can be visualized is cerebral angiography.

In the conventional skull film (B) no abnormal intracranial deposits of calcification are present to suggest this abnormality. The calcification in the pineal is in the normal position. The air studies in C and D reveal no appreciable displacement or abnormality of the ventricular system. In this particular case the air studies were done first but, since they did not determine or localize the lesion, they were followed immediately by the angiographic examination. Note the air-filled ventricular system on the angiogram in A.

was associated with a continuous headache and the patient began to have occasional "fainting spells" and short periods of "complete blackouts." In September of that year a physician detected the characteristic bruit of an intracranial arteriovenous fistula. He performed a craniotomy and tied off some of the large communicating vessels near the brain surface. This resulted in some improvement of symptoms. After a few months the "roaring noise," the continuous headache, and the "fainting spells" all returned and the patient entered a hospital of the Veterans Administration for evaluation and treatment. This history demanded a complete study of the cerebral arterial circulation, with visualization of all the ramifications of

the malformed vessels, in order that the neurological surgeon might properly evaluate the type and extent of treatment that would be most beneficial.

The internal carotid artery on the involved side was first injected, and the huge collection of angiomatous malformed vessels with multiple arteriovenous connections extending from the posterior portion of the frontal lobe back to the tentorium was demonstrated (A).

The second lateral stereoscopic series was made after the injection of an equal amount (7 c.c. of 35 per cent diodrast), and the external carotid artery was inadvertently filled as shown in (B). This was a fortuitous incident, as it demonstrated effective anastomoses of the external carotid artery through the skull with the intracranial angiomatous mass of vessels. Here again is demonstrated the advantage of having a larger series of films in order to pick up the unsuspected complication or unanticipated abnormality.

Figure 12 is the angiographic study made on a forty-six-year-old white farmer who experienced a "stroke" six years earlier, which left him with weakness of the left leg and left arm and an inability to use them effectively. Three years later diplopia developed and had been intermittent ever since.

The important point in this case is to illustrate that huge masses of angiomatous malformed vessels can be present without giving any clue to their presence in the conventional film (B) and without producing any displacement or distortion of the ventricular system or subarachnoid spaces (C and D). The presumably congenital angioma with cirsoid and arteriovenous fistulae of the right middle cerebral artery is well demonstrated in A.

SUMMARY

1. The rapid serialization of x-ray exposures on large-size roll film, 9 1/2 inches in width, is a practical and advantageous radiographic method for cerebral angiography. Satisfactory commercial equipment is now available for this purpose. Special electronic timer and sequencing devices are desirable but are not necessary.

2. For a complete and accurate visualization of the cerebral arterial system a lateral stereoscopic series of films and an anteroposterior series of films should be made for each examination.

3. The roll-film technic uses more film, but it reduces the failures occasioned by "missing" the arterial tree at the moment it is filled. It also provides a sequence of exposures that are helpful in identifying filling defects that are constant and significant.

4. Cerebral angiography involves a definite hazard to the patient, and technics using continuous radiographic exposures assist in reducing the hazard by employing smaller amounts of contrast medium for each injection and by requiring fewer reexaminations due to an incomplete or inadequate visualization of the arterial system.

5. The continued development of more elaborate equipment, as the double rapidograph, for the simultaneous exposure of the lateral and anteroposterior series of films appears justified as a means of further minimizing unfavorable reactions, at least until an innocuous contrast medium is created.

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SUMARIO

Desenvolvimientos en la Angiografía Cerebral con Rápidas Exposiciones Roentgenográficas Seriadas en Rollos de Película de 24 Cm. de Ancho

La rápida serialización de las exposiciones a los rayos X en películas en rollos grandes, de 24 cm. de ancho, constituye un método radiográfico práctico y conveniente para la angiografía cerebral, contándose ya para dicho fin con equipos comerciales satisfactorios. Un cronógrafo electrónico y accesorios serializadores *ad hoc* resultan convenientes, pero no necesarios.

Para una completa y exacta visualización del aparato arterial del cerebro, hay que tomar en cada examen una serie de radiografías estereoscópicas laterales y otra serie anteroposterior.

La técnica de los rollos de película consume más película, pero disminuye los fracasos ocasionados por "no dar" con el árbol arterial en el momento en que se llena. Suministra además una serie de exposiciones que ayudan a identificar nichos que son permanentes e importantes.

La angiografía cerebral entraña un peligro bien definido para el enfermo, y las técnicas que utilizan exposiciones radiográficas continuas ayudan a aminorar el peligro por emplear cantidades más pequeñas del medio de contraste en cada inyección y por exigir menos repetición de exámenes impuestos por la visualización incompleta o inadecuada del aparato arterial.

El continuo desenvolvimiento de equipos más complicados, como la "rapidografía" doble, para la exposición simultánea de las series de radiografías anteriores y posteriores parece justificado como medio de minorar aun más las reacciones adversas, por lo menos hasta que se elabore un medio inocuo de contraste.

Angiocardiographic Diagnosis of Mediastinal Tumors, with Special Reference to Aortic Aneurysms[1]

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Mexico, D. F.

ONE OF THE MOST important contributions of modern endothoracic surgery has been to make possible operative procedures in the mediastinum. With improvement in the methods of examination already known (roentgenology, endoscopy) and the use of newer procedures, as angiocardiography, the mediastinum has become more accessible to the clinician and its anomalies easier to diagnose, though erroneous interpretation of the nature of the damage, in the absence of exploratory thoracotomy, is still too frequent.

Among 95 cases studied by the authors, there were 33 mediastinal tumors, including 16 aortic aneurysms. Of these last, 14 were diagnosed angiocardiographically and 2 at autopsy.

The diagnosis of mediastinal tumors has gone through three stages: the clinical stage, the roentgenographic stage, and the latest stage, that of angiocardiography.

(1) Clinically, syndromes referable to the mediastinum were classified on the basis of symptoms due to compression upon the organs and structures contained therein. Thus symptom complexes were described indicative of compression upon the trachea, esophagus, great arterial and venous vessels, nerves (sympathetic, vagus, recurrent laryngeal, phrenic), ganglia, etc. In this way, more or less exact localization of the lesion was determined, but deductions as to its nature were frequently at fault.

(2) Roentgenologic examination of the mediastinum is carried out in the classical positions: postero-anterior, oblique, and lateral, the last two giving the most reliable information as to tumor localization. In these two views, the classical divisions of the mediastinum (1) are clearly shown, the anterior and posterior appearing lighter, owing to the presence of air in the pulmonary parenchyma, and the middle darker, due to the higher index of opacity of the cardiovascular shadow.

The roentgen study is a most valuable diagnostic aid, permitting quite accurate localization of the lesion, for experience has demonstrated that certain pathologic processes have a tendency to localize in certain of the accepted divisions of the mediastinum. Diseases of the lymph nodes, simple enlargements or neoplasms of the thymus gland, intrathoracic goiters, teratoid tumors, bronchiogenic cysts, and aneurysmal processes of the anterior portion of the ascending aorta—all having a tendency to forward displacement—are always in the anterior mediastinum. We found 13 tumors localized in this region, of which 6 were aortic aneurysms, 2 teratomas, and 1 a lymphosarcoma. In the remaining 4 cases the nature of the tumor was not determined.

The middle mediastinum is the region of lymphatic abnormalities (Hodgkin's disease, lymphosarcoma, sarcoidosis), aortic and pulmonary aneurysms, bronchiogenic carcinoma, and rarely cystic formations. Eight of the cases studied by us were localized in the middle mediastinum: 6 were aortic aneurysms and 2 abnormal processes in which it was not possible to establish the diagnosis.

The posterior mediastinum is the region of vascular tumors (aortic aneurysms), esophageal and tracheal abnormalities, and neurogenic tumors (neuromas, ganglioneuromas, and meningiomas). We have found 12 tumors in this portion; 4 were aortic aneurysms, 1 an esophageal fibroma, and 1 an aberrant thymus. In the remaining 6 cases it was not possible to arrive

[1] Accepted for publication in May 1950.

at an etiologic diagnosis. The aberrant thymus was found in a young woman, just above the diaphragm (2). It was successfully extirpated and the existence of thymic tissue was verified histologically.

From the foregoing, it will be observed that aortic aneurysms do not develop in any particular portion of the mediastinum; as the aorta traverses all three divisions, the condition may appear in any one of them. There are certain evidences, however, which assist in the diagnosis of the site of the lesion, such as the fact that aneurysms of the ascending portion usually emerge in the right hemithorax (3 cases), those of the aortic arch in the left hemithorax (11 cases), and those of the descending aorta in the left hemithorax and anteriorly (2 cases).

Roentgenographically, an aortic aneurysm is evident in the anteroposterior and lateral views as a homogeneous shadow, with displacement or destruction of neighboring structures. The shadow is usually well circumscribed, though in one patient in our ward with blood-stained sputum and a right mediastinal shadow with irregular upper and external margins, who died after a fulminating hemoptysis, postmortem examination disclosed an aneurysm of the ascending portion of the aorta, opening into a branch of the superior right bronchus (Fig. 1). In two of our patients we found basal bronchopneumonic lesions, in the right lung in one and in the left lung in the other, most probably due to retention and infection of secretions as a result of compression by the mass upon the trachea and corresponding bronchus (Fig. 2).

(3) In these days, in addition to the methods outlined above and surgical exploration of the mediastinum, we have certain roentgenologic methods making use of artificial densities to secure contrast where this is not naturally available. There are many of these methods; we will mention only pneumomediastinum and angiocardiography; the former, infrequently used, is indicated mainly in children in an attempt to make a differential diagnosis between diseases of the thymus gland and those of the lymph nodes; angiocardiography is a valuable aid in diagnosing mediastinal tumors.

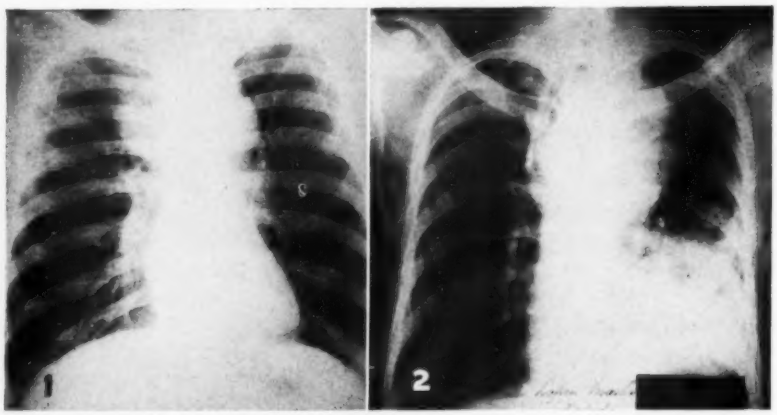

Fig. 1. Aneurysm of the ascending portion of the aorta opening to a branch of the superior right bronchus.
Fig. 2. Aortic aneurysm causing a left pneumonic process due to obstruction of the air passages.

In 1946 one of us (3) presented several cases of aortic aneurysm diagnosed by means of angiocardiography, and the following year Chávez, Dorbecker, and Celis (4) reported a case of aortic aneurysm in the left sinus of Valsalva, which compressed the infundibulum of the pulmonary artery. Sussman (5), in 1947, stressed the import-

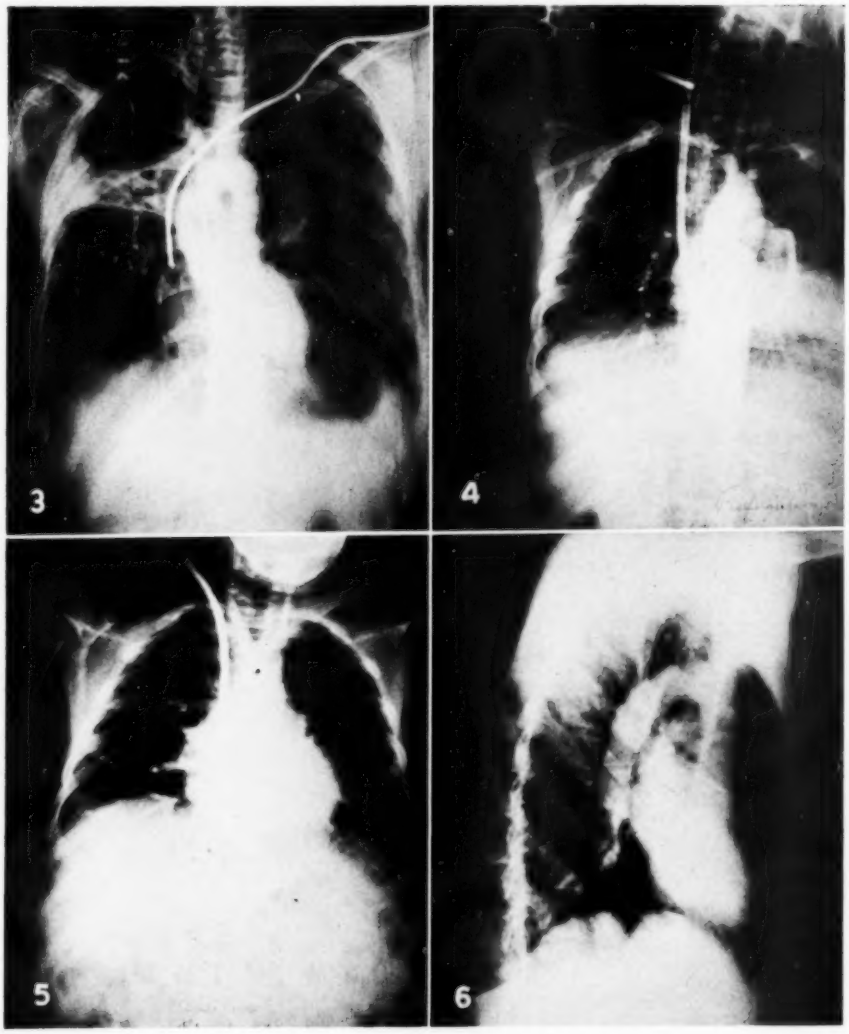

Fig. 3. Angiogram of a normal thoracic aorta in the anteroposterior position. The left ventricle is also opacified.

Fig. 4. Angiogram of a normal thoracic aorta in the anteroposterior position. The vessels of the neck and right superior extremity are also opacified. The distal end of the catheter is in the left branch of the pulmonary artery.

Fig. 5. Angiogram of the thoracic aorta, blood vessels of the neck, and pulmonary veins. The opaque medium is injected twice at intervals of a few seconds in order to opacify simultaneously both pulmonary veins and aorta.

Fig. 6. Angiogram of the normal aorta in the lateral position. The left ventricle is also opacified.

ance of angiocardiography in mediastinal tumors and reported 3 cases in which a positive diagnosis was made. In 1948, Meneses Hoyos and Gomez del Campo (6) reported 2 cases in which direct aortography established the diagnosis of aneurysm of the descending aorta. Dotter and Steinberg (7) pointed out the accuracy of angiocardiographic measurements of the thoracic aorta, and in a later communication (8) reported 3 cases of aortic aneurysm demonstrating the value of the procedure. At the meeting of the Association for Thoracic Surgery in March 1949, the prop-

osition of Abbott, Hopkins, and Leigh (9) that the angiocardiogram has a decisive value in diagnosing aortic aneurysms was approved.

In our work at the General Hospital, it was a mistake in diagnosing a tumor situated in the posterior mediastinum that led us to study and use angiocardiography in all cases of mediastinal tumors. In the case referred to, clinical and roentgenologic studies were indicative of aortic aneurysm and operation was performed using Babcock's technic (anastomosis of the common carotid artery with the internal jugular vein). A posterior exploratory thoracotomy disclosed the presence of a fibroma in the esophagus, which was successfully resected. This case served to demonstrate the necessity of vascular opacification in the diagnosis of mediastinal syndromes.

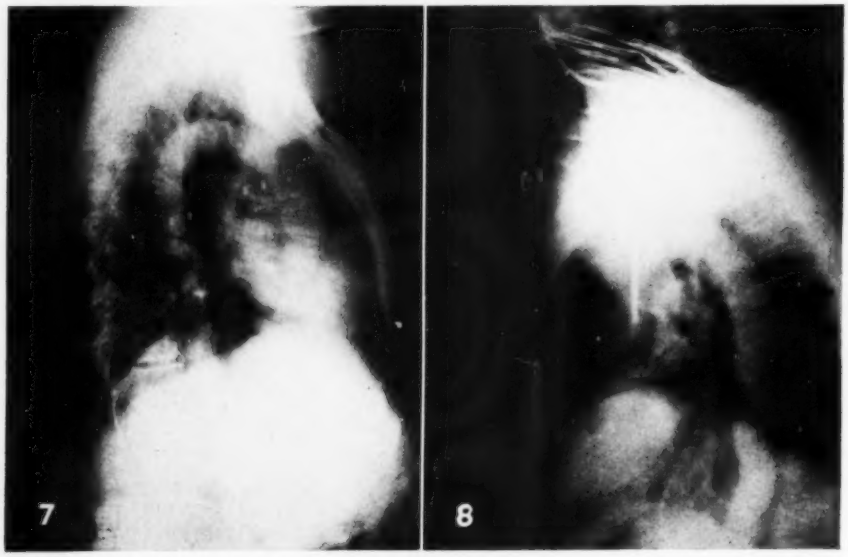

Fig. 7. Angiogram showing the aorta slightly straightened. Its intrapericardial portion can be easily detected.
Fig. 8. Tortuous aorta in its inferior thoracic portion.

Our first attempts were made with methods reported by others, namely Castellanos' technic of intravenous injection, using the median cephalic vein at the bend of the elbow (10–12), and auricular catheterization by way of the median basilic vein as described by Portuguese investigators (13). The results obtained, however, were far from satisfactory. This led us to devise a method of our own, which we are still using. Briefly, this consists in catheterization of the right cardiac chambers or pulmonary artery, using a Nélaton catheter. The catheter is introduced through the right or left external jugular vein, the circulation time (distal end of the catheter tongue) is then taken, after which 40 to 50 c.c. of an opaque substance are injected and roentgenograms are obtained at the required intervals to secure images of the cardiac chambers or great vessels. We have obtained 311 angiocardiograms by this technic.

To obtain roentgenograms after the aorta has been opacified, the anteroposterior or lateral position (preferably the latter) is customarily used, with spacing of the films in accordance with the circulation time (minus one second). It is fairly easy to obtain angiocardiograms of a dilated aorta, as the passage of the opaque substance is retarded by the ectasis. Under normal conditions the task is more difficult, as the

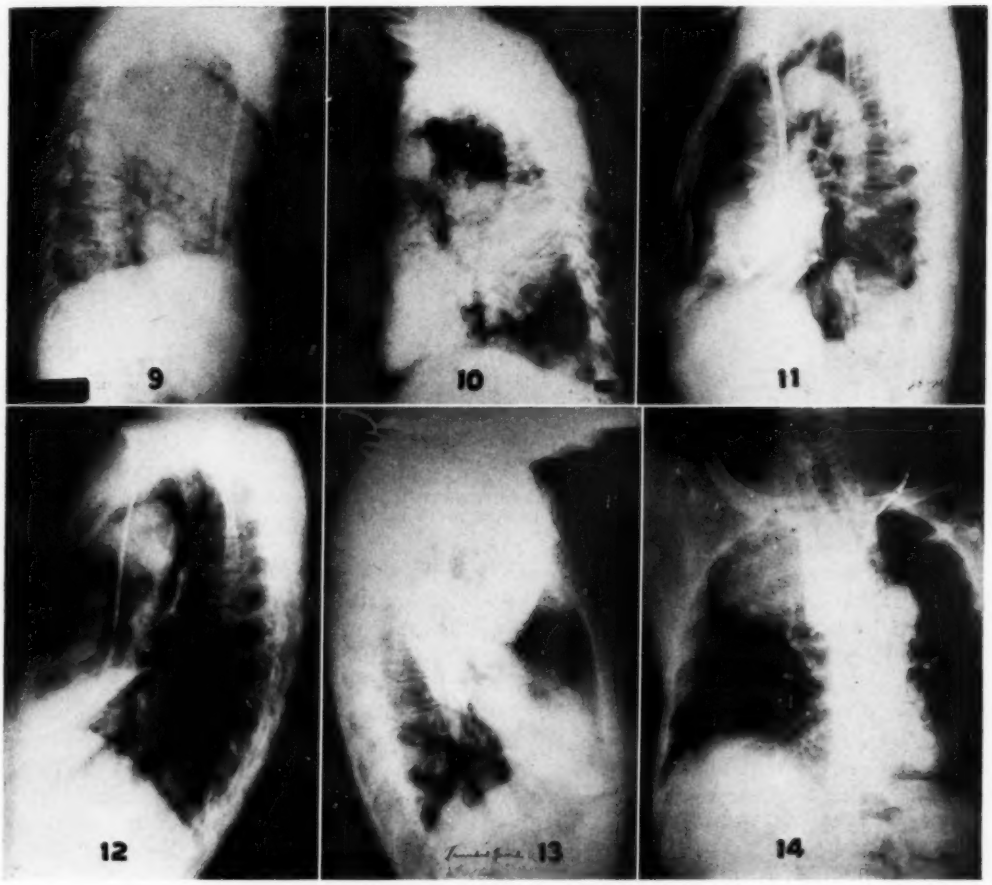

Fig. 9. Aneurysm of the anterior portion of the aorta.
Fig. 10. Three aortic aneurysms. Notice the lack of opaque substance between one dilatation and the other.
Fig. 11. Saccular aneurysm whose point of exit lies axial to the x-ray tube.
Fig. 12. Aneurysm in the transverse portion of the aorta. The shadow of the aneurysm is superimposed on the shadow of the vessel.
Fig. 13. Saccular aneurysm of the ascending portion of the aorta. Notice the "approximation of the aortic portions" due to the fact that the aneurysm pushes back the aortic arch.
Fig. 14. Aortic aneurysm. Notice the lesser degree of opacity in its periphery due to the presence of clots.

medium flows rapidly through the descending aorta. Nevertheless, we have been successful in opacifying the normal aorta and have obtained 47 aortograms.

The thoracic aorta is divided into two parts: the aortic arch and descending thoracic aorta; the aortic arch in turn is divided into three portions: ascending, transverse, and descending. The ascending portion, for purposes of our study, is considered as consisting of two parts: intrapericardial and extrapericardial. The former cannot be visualized due to the superimposed shadows of the auricle, conus, and pulmonary artery (14).

Roentgenologic study in the various positions shows only certain portions of the thoracic aorta. Our method, however, allows the introduction of the opaque medium into the right ventricle in sufficient quantities and at the necessary speed to reduce to a minimum the probability of its mixing with the blood. It therefore reaches the aorta with little or no dilution and is thus sufficiently radiopaque to make possible the complete visualization of this

Fig. 15. Aneurysm of the ascending portion of the aorta. Narrowing of the aortic arch and "approximation of the aortic walls."
Fig. 16. Aneurysm of the ascending portion of the aorta with approximation of its walls.
Fig. 17. Tumor in posterior mediastinum. The aortic angiogram is normal, conclusive evidence on which to base a differentiation from aneurysm.

vessel, with its contours, diameters, and main branches. Of the several positions used to obtain roentgenograms of the opacified aorta, the lateral gives the best results, as it brings out each of its divisions.

The postero-anterior position is inadvisable, since the shadow cast by the ascending aorta will be superimposed upon that of the descending portion, and the transverse portion, a frequent site of aneurysm, cannot be visualized.

In the anteroposterior angiocardiogram the normal aorta appears as a club-shaped structure, with parallel walls (Fig. 3), emerging from the superior portion of the left ventricle, passing upward and toward the right, describing an externally convex curve. Its uppermost portion—the aortic arch—crosses the vertebral column toward the lower part of the thorax and continues on to the abdomen.

In the lateral view (Fig. 6), the aorta is seen emerging from the left ventricle, showing first its intrapericardial portion, which can be visualized only by angiocardiography. It is limited below by the semilunar valves, continues upward and slightly forward, appearing as a cord of greater opacity than the other intrathoracic structures, and then approaches the sternum and takes a backward course, giving off its branches to the neck and upper extremities (branches which are easily visualized since they fill readily with the opaque medium). It then travels downward to reach the inferior portion of the thorax and abdomen, lying parallel to the vertebral column.

There are two points at which the aorta is firmly adherent to neighboring structures: first, the point where it leaves the left ventricle; second, at the level of the aortic opening in the diaphragm, where the abdominal aorta begins. The presence of these fixed points results in the tortuous appearance of the vessel whenever there is an alteration of its walls tending to increase its length (Figs. 7 and 8).

On the basis of our studies, angiocardiographyprovides the following data for diagnosing thoracic aortic aneurysms:

1. Delay of the circulation time up to fourteen seconds from a normal of six or seven seconds, when the aneurysm is located before the aorta gives off its branches to the head and upper extremities.

2. Interruption of the parallelism of the aortic walls (Fig. 9), both walls in fusiform aneurysm and one in saccular aneurysms.

3. Escape from the aorta of the substance used for opacification (Fig. 10).

4. Shadow superimposed on that cast by the aorta, with an increase in density due to the sum of both shadows projected in the same plane (Fig. 11). In this case we are dealing with a saccular aneurysm whose point of exit lies axial to the x-ray tube (Fig. 12).

5. In opacifying an aneurysm, one of two things may occur: the opaque medium may be well distributed, up to the periphery, so that the limits are well marked (Fig. 13), or it may not reach the periphery, and thus the image will be that of a central shadow with a halo (Fig. 14). The appearance of this halo is due to the presence of clots located in the periphery of the aneurysmal sac, which cannot be reached by the opaque substance.

6. To diagnose an aortic aneurysm, it is essential that the shadow produced by the mediastinal process be of the same degree as the one produced by the aorta in the angiogram and greater than the shadows cast by neighboring non-vascular structures (Fig. 15). In saccular aneurysms of the anterior wall of the ascending aorta, we have corroborated Kienböck's sign, which consists in depression of the aortic arch (Fig. 14); we have also observed an approximation of the ascending and descending portions of the aorta as it sharply bends upward and backward in this type of aneurysm, as seen in the lateral position (Fig. 15). This sign, which is not reported in the literature, might be called "approximation of the aortic portions."

Our experience in the angiocardiographic diagnosis of aortic aneurysms is based on 14 cases in which the distinction between aneurysm and mediastinal neoplasm was proved. In 3 suspected cases of aneurysm the differentiation from tumor could not be made (Fig. 17).

CONCLUSIONS

In most cases, clinical and roentgenologic studies alone are insufficient to arrive at a diagnosis as to the nature of a mediastinal tumor. We believe that angiocardiography is the method of choice for the diagnosis of aortic aneurysms.

Ninety-five cases were studied roentgenographically and angiocardiographically, of which 33 were mediastinal tumors, including 16 aortic aneurysms.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Diagnóstico Angiocardiográfico de los Tumores Mediastínicos, con Referencia Particular a los Aneurismas de la Aorta

En este procedimiento para la angiocardiografía, se introduce, por la yugular externa, un catéter en las cámaras cardíacas o vena pulmonar del lado derecho, se determina el tiempo de circulación y se inyectan después de 40 a 50 cc. de medio de contraste. Luego se toman radiografías a plazos apropiados. Las vistas laterales son las más útiles. Este método ha resultado del mayor valor para diferenciar los aneurismas aórticos de las neoplasias del mediastino.

También aparecen descritos el aspecto de la aorta normal y el de los aneurismas de dicho vaso. Un signo de aneurisma sacular de la aorta, no comunicado hasta ahora, consiste en la aproximación de las porciones ascendente y descendente de la aorta donde se encorva bruscamente hacia arriba y atrás.

Thorium X Treatment of Skin Epithelioma, Keratoses, and Delayed Radiation Changes[1]

J. I. SHER, M.D., and WILLIAM E. HOWES, M.D.

EPITHELIOMAS, as well as keratoses and superficial radiation injuries, can be successfully eradicated by applying thorium X in solution or in an ointment, the effect being due apparently to the intense ionizing properties of the alpha particle. Unsatisfactory sequelae such as ugly scarring, keloid formation, depigmentation, telangiectasis, or other untoward radiation effects have not been observed to date.

Thorium X should not be confused with thorium or thorium compounds. The thorium paste used by Bulkley (1) did not contain thorium X but thorium oxide in combination with other chemicals. The action of this paste was mainly a caustic one, not dependent on its radioactive qualities.

HISTORY

Due to scarcity of radium in Germany, investigators turned to mesothorium as a source of radiation energy. As early as 1912 independent reports by Bickel (2) and Pappenheim (3) appeared in the German literature. Both referred to the oral administration of thorium X in the treatment of anemia and leukemia. The following year Naegeli and Jessner (4) reported on the efficacy of the external application of thorium X in the treatment of psoriasis, neurodermatitis, lupus erythematosus, and lupus vulgaris. Further work dealing with the local application of thorium X in chronic dermatoses was carried out by Fabry (5, 6, 7), Jadassohn (8), Nagelschmidt (9), Pinkus (10), and Prosser Thomas (11). In reporting his experiences with thorium X in the treatment of nevus flammeus (port-wine mark) and various dermatoses, Prosser Thomas indicated that he had also successfully treated several of the flat, cicatrizing superficial basal-cell lesions. He is therefore to be regarded as the pioneer in the treatment of skin epithelioma by this means.

Except for the workers listed above, all those reporting on the use of thorium X have described its application in needles with various filtration, simulating radium and radon therapy technics. When thorium X is thus enclosed in a metal sheath, the beta and gamma factors only are utilized, and as some 99 per cent of the energy emitted is in the form of alpha particles, immeasurably larger amounts are necessary to produce any biological effect. The needles used contained 500 μc. (microcuries) or 0.5 mc. of thorium X per centimeter of length, on the basis of Halberstaedter's (12) researches in 1923.

Alpha rays from radon have been utilized by Uhlmann (13), Low-Beer and Stone (14), and others. They kneaded radon gas into a vaseline base to treat post-irradiation skin injuries and have reported good results. The concentration of radon ranged from 17 to 34 μc. (50–100 e.s.u.) per gram of vaseline. Uhlmann contended that the healing effects observed were due to stimulation of the epithelial cells as a result of alpha particle bombardment. Radium D, with a half-life of twenty-two years, may be absorbed from radon ointment and can be considered as a potential if not an actual radiation hazard, not associated with the breakdown of thorium.

PHYSICAL PRINCIPLES

Thorium X is a radioactive element obtained by separation from its parent element radiothorium. It has a half-life of 3.64 days. It emits principally alpha particles ranging in energy from 5.5 to 8.8 mev (million electron volts) and having a mean range of from 4 to 8.5 cm. in air and

[1] Read by title at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949. Accepted for publication in April 1950.

TABLE I: ION DENSITY PRODUCED BY DIFFERENT IONIZING PARTICLES

(From Supplement No. 1, Brit. J. Radiol., edited by F. G. Spear, by permission. Natural disintegration of thorium X added.)

Radiation	Mode of Generation	Mean Linear Ion Density (Ions per Micron of Tissue	Ionizing Particle
	Theoretical minimum ion density for any particle	6.3	
Very high energy β and γ radiation	20–30 million volt betatron Natural and artificial radioelements	8.5	
γ radiation	Radium screened by at least 0.5 mm. platinum as used in radiotherapy	11	
X radiation	"Supervoltage" 1,000 kv. installation	15	Electron
	"Deep therapy" 200 kv. installation	80	
	X-ray tubes operated at 30–180 kv	100	
	"Characteristic" x-rays — Cyclotrons operating at		
	Copper K (8 kv.)	145	
	12 million volts	290	
	Silver L (3 kv.)	300	
	8 million volts	380	
Neutron radiation	Aluminum K (1.5 kv.)	460	Proton
	High-voltage ion tubes		
	900 kv. Deuterium ions bombarding lithium	840	
	400 kv. Deuterium ions bombarding deuterium	1,100	
	Natural disintegration of thorium X	5,000	
α radiation	Natural disintegration of radon	3,700	α particle
	Natural disintegration of polonium	4,500	
	Artificial disintegration of boron or lithium by slow neutrons	9,000	Atomic particle
Atomic rays	Uranium fission	130,000	

of the order of 40 to 80 microns (0.4 to 0.8 mm.) in tissue (Table I).

A study of thorium X decay (Table II) shows that, upon separation, the immediate decay products (Tn and Th A), because of their own high rate of production and decay, will follow the decay rate of the thorium X. Thorium B, however, has a relatively low decay rate (10.6 hour half-life) compared with the others, and together with its immediate decay products (Th C, Th C′ and Th C″) will build up more slowly. These products, because of their short lives, will follow the thorium B rate of build-up and decay. Thus the alpha activity of the thorium X series does not follow a simple exponential curve but rather presents a complex relationship consisting of the sum of two groups of alpha emitters, similar to the gamma radiation, *vs.* time curve for radon.

If to the thorium B group, whose radiations start at zero and build up to a maximum in about 1.5 days, is added the thorium X group, which decays exponentially from its initial value, a curve is obtained which shows that the maximum total alpha activity is attained in slightly less than one day after separation, as shown in Figure 1. If any thoron, which is a gas, is permitted to escape, the activity will be reduced in quantity in proportion to the loss of thoron.

Of the entire thorium X series, the only constituents known to be other than alpha emitters are Th B (beta rays only) and Th C (beta plus gamma rays). In equilibrium, which is reached in about four

TABLE II: DECAY CHARACTERISTICS OF THORIUM X

Element	Half-Life	Rays Emitted	Average Energy of Alpha and Beta Particles in Mev
Thorium X	3.64 days	Alpha	5.68
Thoron (a gas)	54.5 sec.	Alpha	6.28
Thorium A	0.16 sec.	Alpha	6.78
Thorium B	10.6 hrs.	Beta	0.36
Thorium C	60.5 min.		
66.3% Beta		Beta	2.20
33.7% Alpha		Alpha	6.05
Thorium C'		Alpha	8.78
Thorium C''	3.1 min.	Beta and Gamma	1.82 2.62
Thorium D			

Note that all of the decay products below thorium X have a much shorter half-life than thorium X.

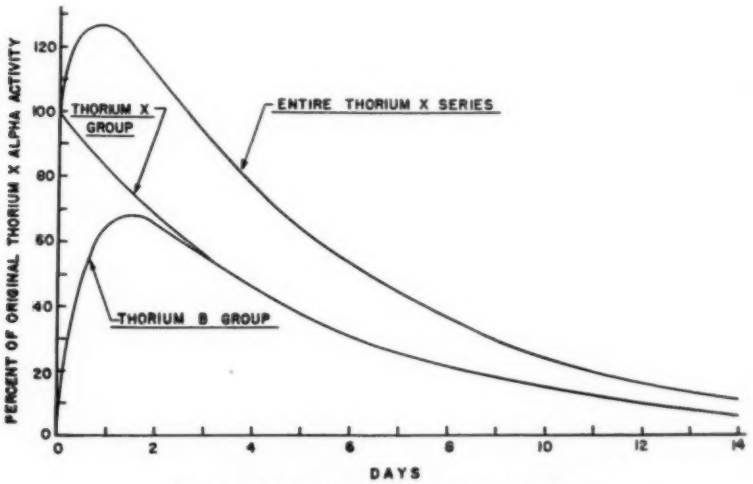

Fig. 1. Alpha activity of the thorium X series.

days after separation, each level of the series disintegrates at an equal rate of 37 million disintegrations per second per millicurie. Inasmuch as only two-thirds of the Th C disintegrations involve beta and gamma emissions, the total beta (Th B and Th C) activity of the series would accompany only approximately one-fourth of the total disintegrations, and gamma (Th C) less than 10 per cent. Because of the very much higher specific ionization of alpha particles than either beta or gamma rays, it is estimated that the alpha component represents over 99 per cent of the total ionization. This intensity of ionization would presuppose a marked biological effect within their limited paths.

Measurements have shown that these alpha particles will in general penetrate less than 80 microns (0.08 mm.) in substances of tissue equivalent density. On the other hand, it has been demonstrated clinically and experimentally that the effects of alpha radiation from thorium X are discerned at a greater depth, 300 microns (0.3 mm.) (Lomholt, 15). This

apparent discrepancy may be explained as follows:

(1) Thorium X in alcoholic solution is probably absorbed through some distance in tissue.

(2) The first decay product of thorium X, thoron, being an inert gas, may diffuse to some extent through tissue.

(3) Thorium X probably penetrates deeper by diffusion through neoplastic and inflammatory tissue than through normal skin protected by a keratinized surface.

The beta particle and the gamma ray by their presence contribute a minimal percentage to the total radiation effect. This does not alter the basic concept that the alpha component is the predominating ionizing radiation contributing to the biological result. The minimal beta and gamma energies present are insufficient to produce any of the untoward sequelae which on occasion have followed exposure to x-rays and radium.

GENERAL OUTLINE OF THE APPLICATION OF THORIUM X

Thorium X, in a concentration of 300 μc. (2,000 e.s.u.) or less per cubic centimeter of alcohol or per gram of lanolin, was applied at weekly intervals to all lesions in the series to be reported here. For epitheliomas, eight applications constituted the usual course of treatment. The treated area was then covered with collodion to be sure that the thorium solution would not be washed or scraped off. When an ointment base was applied, a piece of oiled silk or sheet rubber was cut out to cover the area, and the whole dressing was fixed to the surface by adhesive plaster.

The area to be treated is first cleansed with soap and water, followed by peroxide to soften and remove scabs and dried secretions. Finally a grease solvent such as acetone or carbon tetrachloride is applied to make sure that no fat film shall act as a screen. Before applying the solution of thorium X, the area is dried by tamping with sterile gauze.

A cotton-tipped applicator is dipped into the vial containing the thorium X solution and rubbed vigorously over the lesion. With epithelioma, it is best to spread the liquid over an area extending 0.5 to 1.0 cm. beyond the actual edge of the lesion. Five applications are made in succession, with intervals of several seconds between applications to allow the solvent to evaporate. Approximately 0.1 to 0.2 c.c. is used to cover an area measuring 1.0 cm. in diameter. The cotton tip on the applicator must be small, to prevent the dropping or splashing of any excess, as the solution may produce an erythema and subsequent pigmentation even when washed off immediately.

After the final application has dried, a film of collodion is applied. This final application should not be rubbed in, lest any of the radioactive substance be removed. On drying, the collodion will adhere to the skin and, being waterproof, will protect the surface through the usual routine of daily washing, etc. The patient is advised not to pick off the dry collodion. It is lifted off a week later when he reports back for the next application.

BIOLOGICAL REACTIONS TO BE EXPECTED FOLLOWING SURFACE APPLICATION OF THORIUM X

Neoplastic and normal skin differ in their sensitivity to alpha radiation. For example, in treating an epithelioma the solution is generally applied for 1 cm. beyond the edge of the lesion. With biological response the tumor tissue disintegrates, while the adjacent normal skin merely becomes faintly reddened and later pigmented. On occasion, superficial desquamation (dry epithelitis) has been observed as a maximum reaction by normal skin.

As a rule, a faint erythema is manifest within twenty-four hours following the application of thorium X. The intensity of the erythema may increase for several days and then subside with more or less pigmentation. In one week, the following further changes may be observed:

(1) If the lesion is large and secondary infection is present, purulent material will

collect under the collodion. Partial regression of the lesion is the rule.

(2) With smaller lesions and those showing no tendency to inflammatory infiltrate, little else than tumor regression occurs. An erythematous zone (to be followed by pigmentation) usually surrounds the lesion.

(3) As applications are continued from week to week tumor regression is accelerated. As a rule, small lesions, up to 0.5 cm. in diameter, disappear entirely by the third or fourth week. In the case of epithelioma, however, the authors have continued the application for a prescribed course of eight treatments in spite of earlier clinical resolution.

SUGGESTIONS AS TO HANDLING THORIUM X

Safety Measures for Protection of the Operator: Although thorium X is to all intents an alpha emitter, certain minimal amounts of beta and gamma radiation are also given off, and these latter will pass through glass containers. The vial containing the thorium X should, therefore, be shielded with 2 mm. of lead to filter out all beta radiations. If, for any reason, the lead covering is removed, the unshielded vial should be placed at a working distance of at least 24 inches to minimize the amount of beta and gamma radiation reaching the operator. It is best to place the vial on a metal or enamel tray, with paper towels beneath to protect from contamination in case of accidental spilling. The operator should wear an apron or laboratory gown to avoid spillage on his clothing. Provided the amount of thorium X in solution is limited to a few millicuries, there is no danger from inhalation of thoron. It is advisable to keep the vial stoppered except when in use.

Safety Measures for the Protection of the Patient: If care is taken not to splash or spill the liquid, if the concentration is not raised above 300 μc per cubic centimeter, and if the solution is not reapplied for more than the prescribed number of eight treatments, there should be no danger to the patient.

To date, no damaging reactions from external application have been reported in the literature. According to Bloch (16) "No untoward late sequelae have ever been observed during the fifteen years this therapeutic agent has been used at the Breslau Clinic." This absence of complications emphasized by Bloch and others holds true, also, in our experience.

SERIES REPORTED

The series to be reported here included 51 epitheliomas: 46 of the basal-cell variety, 4 squamous carcinoma of the prickle-cell type, and 1 of the mixed baso-squamous type. Microscopic proof of diagnosis was insisted upon before treatment except in those cases of radiation injury where even a small skin biopsy threatened permanent ulceration. For the record it was insisted that even keratoses be biopsied. All sections were studied and reported upon by Dr. Herman Bolker, Pathologist at the Brooklyn Cancer Institute. In case of obvious radiation injury, the criteria for diagnosis were a history of excessive radiation dosage, atrophy, depigmentation, inelasticity of tissue, telangiectasis, sclerosis, ulceration or necrosis, or any combination of these.

Most of the patients were personally treated by Dr. Sher. All cases have been carefully followed and evaluated by both authors.

Case histories of individuals having senile keratoses, basal-cell carcinoma, squamous-cell carcinoma, and radiation injuries have been selected to illustrate the efficacy of treatment with thorium X.

Keratoses: Senile keratoses are frequently multiple, and with time there is danger of carcinomatous change. When numerous, they have in the past posed a difficult therapeutic problem. Thorium X is an ideal therapeutic agent in such a situation. A solution containing 150 to 300 μc per cubic centimeter in alcohol or lanolin rubbed into each of the lesions once or twice at weekly or bimonthly intervals has in our experience eradicated them. If and when new keratoses develop in older, typical actinically damaged skin, it is quite

Fig. 2A. Basal-cell carcinoma. Patient W. M. Gross and microscopic appearance before thorium X treatment.

simple to reapply this substance without danger of further skin damage.

A. E., male, aged 71, had for several years noticed the development of numerous dark, rough spots over his scalp, face, and nose. Several of these scabbed over and, when the scab was raised, bled, suggesting early malignant change. However, when a biopsy was done on the most obvious of these scabbed lesions, on the nose, the report was "keratosis."

Thorium X in a solution of 150 μc. per c.c. of alcohol was applied twice with an interval of one week between treatments. The treated areas became softer, losing their roughened keratotic appearance, with no evidence of untoward sequelae.

Basal-Cell Carcinoma: Basal-cell carcinomas most frequently arise on the face about the nose and eyes. Surgery, x-ray, and radium therapy have proved to be efficient methods of eliminating these le-

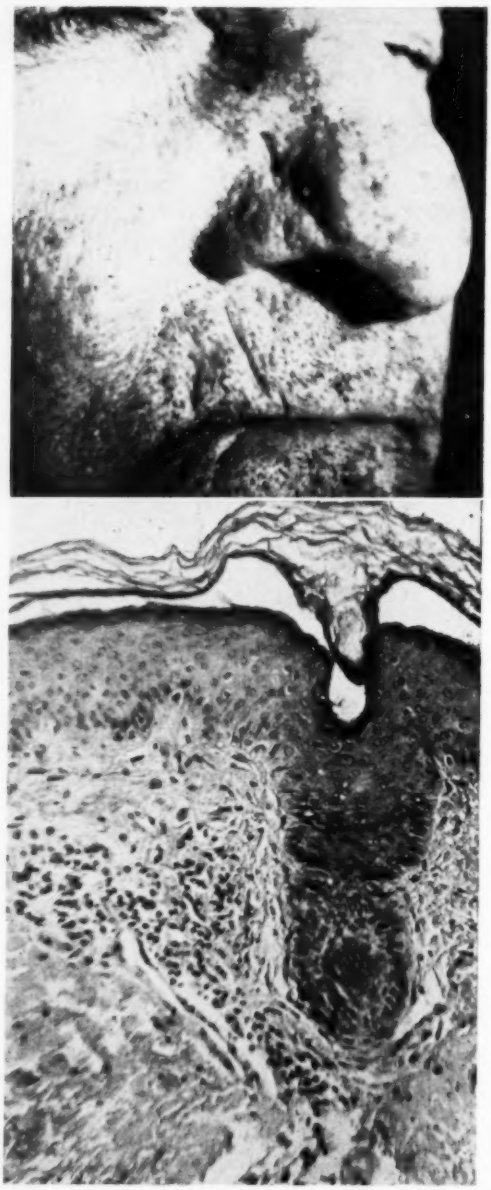

Fig. 2B. Basal-cell carcinoma. Patient W. M. Gross and microscopic appearance after treatment with thorium X.

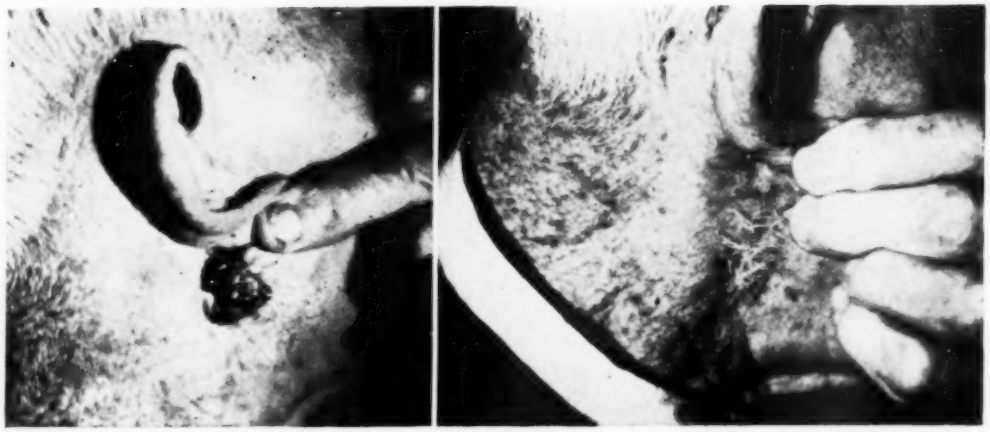

Fig. 3. Squamous-cell carcinoma. Patient H. S., before and after treatment with thorium X.

sions. Thorium X is to be recommended as an additional agent, having the advantage of ease of application and freedom from danger of complication, such as unsightly scarring. Our results have been uniformly satisfactory except where the lesion has advanced to extensive bone involvement.

W. M., male, aged 78 (Fig. 2A and B), recalled the presence of a "sore" on the side of his nose for six months. This had increased slowly in size and on occasion had bled when the scab was lifted. On examination, the lesion measured 0.5 × 0.5 cm.; it was located to the right side of the bridge of the nose. A biopsy report, April 26, 1948, was "basal-cell carcinoma." The usual course of treatment, consisting of eight weekly applications of thorium X in alcohol, 300 μc per cubic centimeter, was carried out.

Another biopsy taken December 1948 from the treated area was reported as showing normal alignment of epidermal structures. The patient was last seen on Sept. 20, 1949, at which time the lesion was clinically controlled, with an almost imperceptible scar.

Squamous Carcinoma: Squamous-cell carcinomas, when superficial and before they have metastasized, have responded equally as well as basal-cell cancers to application of thorium X.

H. S., male, aged 77 (Fig. 3), reported to the clinic because of a fungating granular lesion situated just posterior to the base of the left ear lobe. He stated that this had been present for approximately one year. A physician had fulgurated it when it was but the size of a pea. With recurrence, the growth rate was accelerated and the lesion bled freely on the slightest bruising. On examination it appeared as too bulky for treatment by thorium X; it measured 2.5 cm. in diameter and was elevated 1.0 cm. from the skin surface. A biopsy report, on Nov. 18, 1948, was "squamous-cell carcinoma."

This lesion was first fulgurated to skin surface, and a week later additional biopsies were taken from two sites, showing the persistence of squamous-cell carcinoma. Thorium X in alcohol was applied to the ulcerated base at weekly intervals for eight treatments. The lesion regressed satisfactorily and healed with minimal scarring.

A post-treatment biopsy, on July 1, 1949, showed the presence of sebaceous glands in the area treated, with no evidence of any residual neoplasm. The patient was last observed in the clinic on Sept. 23, 1949.

Radiation Changes in the Skin (Radiodermatitis and Radionecrosis): Radiation injury varies from simple depigmentation with slight atrophy to superficial or deep radionecrosis. Pain is a constant accompaniment of any radiation ulcer. The treatment of residual ulceration following radiation or surgery always poses a difficult problem. Such scar tissue is poorly vascularized and further trauma by surgery or radiation may be fraught with danger of non-healing. In addition, the question is always in mind: "Are residual islands of tumor present?"

Several small areas of radionecrosis were successfully treated in this series. Upon healing of the necrotic ulcer, the surrounding tissue became softer and more resilient and pain was relieved.

M. O., female, aged 80, had received x-ray therapy for a squamous-cell carcinoma on the dorsum of the hand. An area of radionecrosis 1.0 cm. in diameter had resulted. Pain was persistent and almost unbearable. Thorium X, 300 μc per cubic centimeter of alcohol, was applied. When the patient returned for her second treatment one week after the first, the pain of which she had complained so bitterly was notably relieved. Alcoholic solution of thorium X was applied but three times, with the usual weekly intervals. Healing reaction was easily discernible after the second application and in six weeks the necrotic area had epithelialized.

O. G., male, aged 63 (Fig. 4), consulted a local physician in 1939, complaining of an ulceration just anterior to his right ear, of two years duration. The area was electrocoagulated on two occasions but healing did not take place. A biopsy report was "basal-cell carcinoma." The repeated exposures to radiation therapy which followed are summarized:

1934: Contact therapy, 500 r, followed by recurrence.
1936: Radium mold, 1,200 mc. hours. This was not successful and the lesion recurred.
1944: Contact therapy, 10,000 r, followed by residual ulceration or recurrence.

When the patient was referred to this clinic, he had an ulceration located on and just anterior to the tragus, 1 cm. in diameter, covered with a yellow crust. The surrounding zone of induration measured 2 cm. in diameter. The whole area was exquisitely tender and painful. The appearance was that of radionecrosis. Because of the fear that further trauma would spread the area of chondritis, no biopsy was taken in this instance.

Thorium X, in alcohol, was applied three times. Pain eased following the first treatment. In three weeks the necrotic tissue appeared to be separating from the more healthy ulcer bed. Separation was followed by healing with granulations, over which the epidermis regenerated. The early relief of pain with subsequent healing by a soft scar was unexpected, as the ulcer obviously involved cartilage.

Fig. 4. Radiation ulcer. Patient O. G., before and after treatment with thorium X.

F. G., a business woman, aged 45 (Fig. 5), had received a series of x-ray treatments some twenty years previously for hypertrichosis. Since that time she had noted progressive deteriorative changes in the skin, particularly of both cheeks. The scarring became so unsightly that she was forced to cover this blemish with make-up during working hours. Recently the scar on the left cheek had crusted and scabbed over.

The skin over her entire face, particularly the cheeks, was taut and parchment-like, with numerous telangiectases throughout. An area of about 1 sq. cm. on the left cheek was crusted over. On removal of this crust, a raw bleeding surface was disclosed. The patient was advised to remove all make-up and not to reapply it during the treatment period.

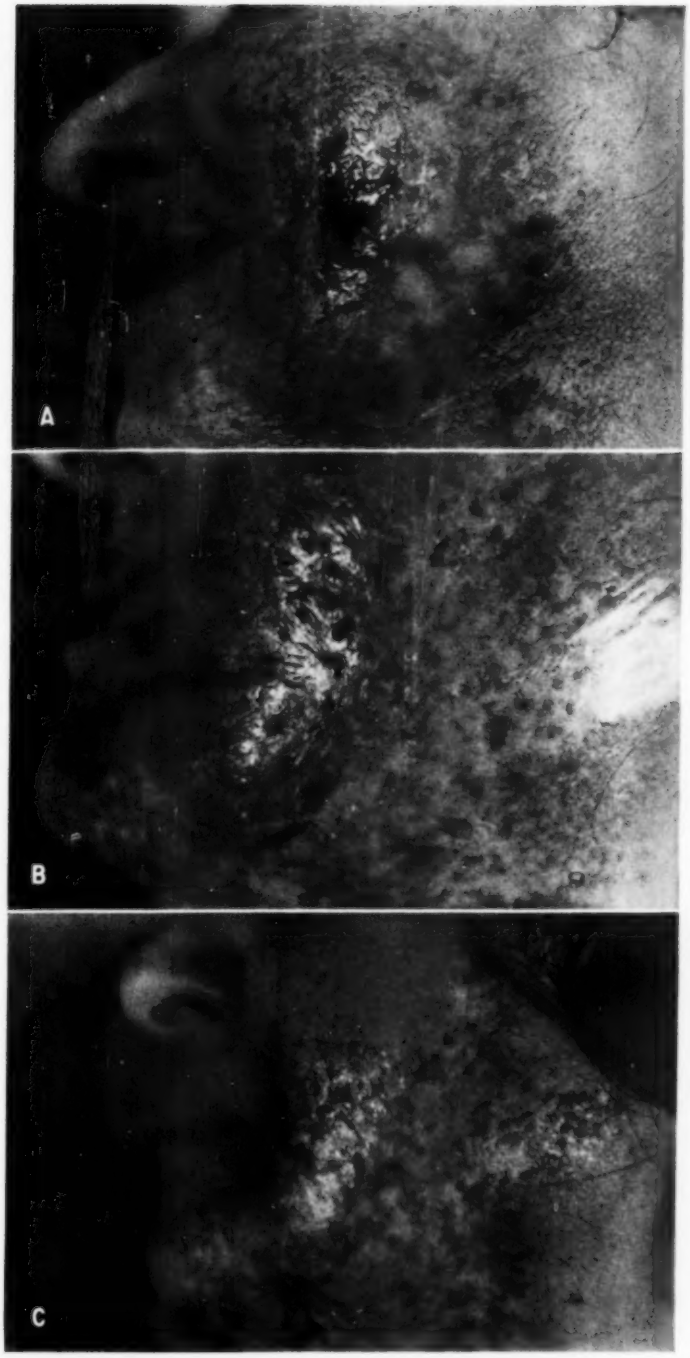

Fig. 5. A. Massive confluent telangiectasis (January 1950) in patient F. G. The extent is partially obscured by incomplete removal of heavy make-up. Lateral to the angle of the lip is a crusted, weeping area. Biopsy disclosed hyperkeratosis. B. During treatment (March 1950). Note erythema reaction. C. After treatment (April 1950). The central crusted area has healed over. The telangiectasis has shown considerable resolution and is no longer confluent. The texture of the skin has improved.

Eight applications of thorium X, 150 μc. per c.c. of alcohol, were made at weekly intervals. Not only did the broken-down area heal, but much of the disfiguring telangiectasis disappeared.

The authors have had uniformly satisfactory results in 50 of 51 cases of skin epithelioma so far treated. A single case, a deep rodent ulcer, did not respond. Keratoses were all satisfactorily eradicated with but two or three applications of the alcoholic solution. This agent appears to be unique in the treatment of radiation injuries, as it was in these injuries that the most satisfactory results were obtained: healing of ulcer, improvement of unsightly telangiectasis, and relief of pain.

SUMMARY

Thorium X in alcoholic solution or ointment, 150 to 300 μc per cubic centimeter or gram, applied directly to the part, is an efficient method of clearing senile keratoses, destroying superficial epitheliomas, as well as improving the cosmetic appearance following radiation damage to skin, and stimulating healing in the case of radionecrosis.

The following advantages are suggested:

(1) Ease of application: The material is either swabbed over (solution) or rubbed (ointment) into the part.

(2) Absence of sequelae: A transient erythema is the rule following one or several applications. Pigmentation may follow the erythema, but no untoward sequelae have been encountered nor were any found in review of the literature.

(3) Cosmetic results: No ugly scarring has been observed. Upon healing, the treated area becomes soft, pliable, and not sensitive.

(4) Absence of danger to adjacent parts: Sensitive organs, as the eye, ear, nose, hair, and even cartilage, have not been affected. Hair follicles and sebaceous glands have been demonstrated by biopsy following repeated application of thorium X in solution.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

El Torio X. Tratamiento del Epitelioma Cutáneo, Queratosis y Alteraciones Irradiatorias Demoradas

El torio X, en solución alcohólica o ungüento, 150 a 300 μc. por centímetro cúbico o gramo, aplicado directamente a la parte afectada, ofrece un método eficaz para disipar las queratosis seniles y destruir los epiteliomas superficiales, así como para mejorar el aspecto estético consecutivamente a las lesiones irradiatorias en la piel, y para excitar la cicatrización en casos de radionecrosis.

Indícanse las siguientes ventajas:

(1) Fácil aplicación: La sustancia es bien pintada sobre (solución) o frotada en (ungüento) la parte afectada.

(2) Ausencia de secuelas: Por regla general, obsérvase un eritema pasajero después de una o más aplicaciones. El eritema puede ir seguido de pigmentación, pero no se han observado secuelas adversas ni encontrado mención de ellas en la literatura.

(3) Efectos cosmetológicos: No se han observado cicatrices afeantes. Al cicatrizar, la zona tratada se vuelve blanda y flexible sin hiperestesia.

(4) Ausencia de peligro para las partes adyacentes: No se han afectado los órganos sensibles, como son los ojos, oídos, nariz, cabello y hasta los cartílagos. Folículos pilosos y glándulas sebáceas han sido encontrados en la biopsia tras la repetida aplicación de torio X en solución.

Irradiation Damage of the Intestines Following 1,000-Kv. Roentgen Therapy. Evaluation of Tolerance Dose[1]

COL. HAROLD I. AMORY, M.C., U.S.A.,[2] and IRVING B. BRICK, M.D.[3]

IT IS HOPED that this study of intestinal damage produced by 1,000-kv. roentgen irradiation will be of value for future radiotherapy. The increasing availability of supervoltage irradiation will help the radiation therapist destroy many abdominal tumors which he has been content to palliate. In so doing he may have to exceed the tolerance of the normal intestine, especially in treating carcinoma of the ovary or kidney, advanced carcinoma of the cervix, and retroperitoneal metastases from testicular tumors.

A typical recent study of radiation injury to the intestine is that of Hock, Rodrigues, Hamann, and Palmer (1), based on 344 cases of carcinoma of the female reproductive system. Analysis of the 19 cases of intestinal injury in this series revealed that in 18 both x-rays and radium were used. In the single case which received x-ray therapy alone, conclusive evidence as to whether the injury was the result of irradiation or neoplastic invasion was not available. As in other series previously reported, the use of both x-rays and radium decreased the accuracy of depth dose determination and made the estimation of tolerance doses more difficult. Practically all the previous reports concern the effect of radiation in females treated for carcinoma of the cervix or body of the uterus. The tolerance dose for the normal small and large bowel was not determined within a sufficiently narrow range to be of practical value, as the combined treatment and the possibility of extension of the primary lesion prevented accurate conclusions.

During World War II, 280 patients with tumor of the testis were treated at Walter Reed General Hospital, the majority by surgery and roentgen irradiation (2). In the series of cases to be reported here, 1,000-kv. roentgen therapy was used for the treatment or prophylaxis of retroperitoneal metastases, whereas previous authors reporting irradiation damage to the intestines have employed lower voltages, 200 to 400 kv. In this group of young patients there was no pre-existing gastrointestinal disease. This fact, which made it possible to study effects of irradiation on the gastro-intestinal tract uncomplicated by disease processes, the use of roentgen therapy alone, and the relatively large size of the group, afforded a unique opportunity to attempt to determine the tolerance dose of the normal large and small intestine in the adult male.

PATHOLOGY

Clinical evidence of injury to the gastrointestinal tract by irradiation was reported by Walsh (3) in 1897, but the first fatal case with autopsy findings was not published until 1917 (4). The histopathology of irradiation injury of the gastro-intestinal tract, in its experimental and clinical aspects, has been completely reviewed by Mulligan (5) and Warren and Friedman (6). The gross pathological findings in the present series were: matting together of the small intestine; twisting and kinking of small intestinal loops; shortening of the colon and small intestine; shortening of the mesentery and mesocolon; thickening and rigidity of the intestinal wall; stricture

[1] From the Radiological Service and Gastroenterology Section, Walter Reed General Hospital, Washington, D. C. Presented at the Eastern Conference of Radiologists, March 11, 1949, Washington, D. C. Accepted for publication in June 1950.

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TABLE I: CASES SHOWING SEVERE AND MODERATE INTESTINAL DAMAGE

Case No.	Recorded Depth Dose to Retroperitoneal Region	Calculated Depth Dose to Transverse Colon	Duration of Therapy (days)	Roentgen Findings	Duration of Life After Therapy (months)	Autopsy Findings
			Cases Showing Severe Damage			
1	6,408 r	6,933 r	43	Constriction of mid-transverse colon; marked segmentation in small intestine	20	Necrotic descending colon and shortening of small and large intestine
2	6,105 r	6,527 r	51	Constriction of transverse colon	27	Ulceration and perforations of transverse colon; perforation of gangrenous small intestine; mesentery greatly shortened, thick, firm, and leathery
3	6,456 r	6,907 r	27	Constriction and fixation of mid-transverse colon; shortening of mesocolon	34	Ulceration of colon; perforation of small intestine; shrinkage of mesentery and mesocolon. (No residual tumor)
4	6,032 r	6,454 r	54	Constriction of transverse colon; shrinkage of mesocolon	18	No autopsy. Died at home
5	5,952 r	6,368 r	63	Constriction of mid-transverse colon with obstruction	14	Constriction and ulceration of mid-transverse colon with necrosis of mucosa and submucosa
6	6,750 r	7,222 r	61	Constriction of distal transverse colon; shortening of colon. Appearance that of ulcerative colitis	31	Small intestine shortened; mesentery and mesocolon matted together; constriction of colon near splenic flexure
7	6,226 r	6,661 r	61	No examination	11	Perforations of ileum; colon normal. (No residual tumor)
8	6,300 r	6,741 r	62	No examination	39	Perforation and multiple ulcerations of ileum. (No residual tumor)
			Cases Showing Moderate Damage			
9	5,512 r	5,897 r	55	No examination	16	Constriction of colon near hepatic flexure
10	5,568 r	5,957 r	55	Constriction, ulceration, and shortening of colon and mesocolon	47	Ulceration of mucosa of colon
11	10,350 r	11,074 r	126	Shortening of colon and mesocolon; dilatation of small intestine and coarsening of mucosal folds	23	Matting of small bowel and colon; shortening of mesocolon and mesentery. (No residual tumor)

of the small intestine and colon; ulceration of wall of small intestine and colon, including hemorrhage and perforation. Extensive shortening of the colon, mesocolon, small intestine, and mesentery has not previously been emphasized as an effect of irradiation.

In a review of the literature there was found a small group of cases which have not been distinctly stressed. The reports by Cathie (7), Todd (8), Cosbie (9) and Engelbreth-Holm (10) include a small number of fatalities within five to fifty-one days following the usual dosage of

TABLE II: CASES SHOWING MILD INTESTINAL DAMAGE

Case No.	Recorded Depth Dose to Retroperitoneal Region	Calculated Depth Dose to Transverse Colon	Duration of Therapy (days)	Roentgen Findings	Duration of Life After Therapy* (months)	Autopsy Findings
12	4,176 r	4,468 r	47	Constriction and ulceration of mid-transverse colon; shortening of colon and mesocolon	13	Constriction of mid transverse colon with old healed ulcer. (Extensive pulmonary metastases)
13	5,232 r	5,598 r	60	Irritability of transverse colon; elevation of transverse colon; shortening of mesocolon; normal small intestine	L-43	
14	5,488 r	5,872 r	73	Enlargement and loss of haustral markings of mid-transverse colon; small intestine normal	L-43	
15	6,100 r	6,527 r	74	Irritability of mid-transverse colon; small intestine normal	L-51	
16	4,150 r	4,440 r	71	Not examined	L-A 48	
17	6,250 r	6,687 r	81	Not examined	L-A 47	
18	6,110 r	6,537 r	83	Not examined	L-A 44	
19	6,350 r	6,794 r	67	Not examined	L-A 48	
20	6,350 r	6,795 r	82	Not examined	L-A 53	

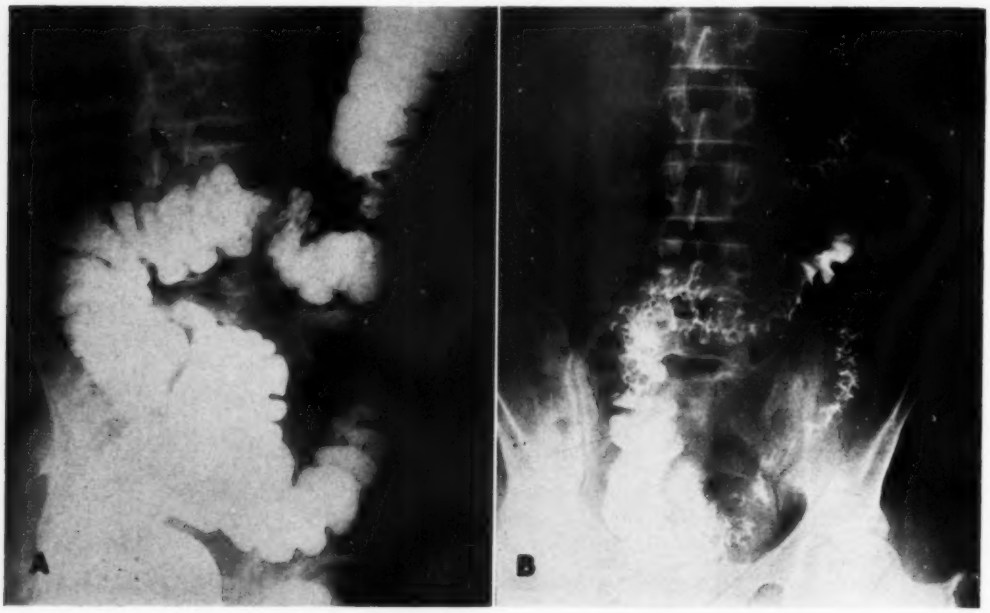
* L. Living. L-A. Living and asymptomatic.

irradiation to the abdomen or pelvis. At necropsy it was determined that the extent of damage to the small and large intestine was not confined solely to the intestine underlying the irradiation portals. In effect, a massive reaction of the intestine similar to an extensive ulcerative process occurred, with a rapidly fatal result. Engelbreth-Holm reported 4 such fatalities among 100 autopsied cases of carcinoma of the cervix treated by irradiation. In Cathie's series of 300 to 400 cases there were 2 early fatalities following irradiation. Such rapidly fatal effects were not encountered in our series.

It is possible that this type of fatal reaction occurs less frequently following supervoltage therapy than when lower voltage is used. The reduction in the total amount of tissue exposed to ionizing radiation by virtue of less scattering in the tissues surrounding 1,000-kv. beams as compared with beams of lower intensity may decrease the toxic effect. The frequently observed decrease in incidence and severity of irradiation sickness in supervoltage therapy tends to support this view.

METHOD OF THERAPY

The factors used in irradiating the retroperitoneal region were 1,000 kv., 3 mm. tungsten filter, 3.9 mm. lead half-value layer, 70 cm. target-skin distance, 86 r per minute (in air). A daily skin dose of 400 to 600 r was delivered through portals measuring 10 × 10 cm. or 10 × 15 cm. Opposing portals were used, the lower dorsal and epigastric portals being centered at the level of the 11th dorsal vertebra, while the lumbar and umbilical portals were centered at the level of the 4th lumbar vertebra. Data used in this study were taken from the umbilical and lumbar portals because the transverse portion of the colon lies in their upper half, generally at the level of the 3d lumbar vertebra. In determining the quantity of radiation received by the transverse colon, as listed in Tables I and II, it was necessary to increase the recorded depth doses by 7 per cent to compensate for the anterior position of the mid-portion of the transverse colon. The depth dose in the central 7 cm. of tissue was remarkably uniform, varying only 5 per cent.



CASE REPORTS

In Tables I and II are included 20 cases receiving intensive irradiation therapy, which form the basis of this report. Fourteen of these patients received over 6,000 r at the level of the 4th lumbar vertebra, and 4 of the remainder over 5,000 r depth dose. Eight of the patients are living and asymptomatic forty-three to fifty-three months after completion of therapy. The essential roentgenologic and autopsy findings are listed in the tables.

In Table I are included 11 cases, 8 with severe and 3 with moderate irradiation damage to the small intestine and/or colon. All of these patients died, and 10 came to autopsy. In Table II are included 4 cases of mild irradiation damage to the intestine diagnosed primarily by roentgenologic findings. The single death among these 4 cases was due to extensive pulmonary metastases from the primary testicular tumor. There are also listed in Table II 5 cases in which roentgen examinations were not done; these patients are living and without gastro-intestinal symptoms forty-four to fifty-three months after completion of radiation therapy. One of this latter group received a depth dose of 4,440 r, but the other 4 received over 6,000

Fig. 1. Case 3. A. Constriction of transverse colon ten months after irradiation.
B. Retention of barium in damaged segment of transverse colon ten months after irradiation.
C. Extensive constriction of transverse colon thirty-one months after irradiation.

r, indicating that a large dosage of supervoltage irradiation does not invariably lead to the effects on the intestine listed in Table I.

There have been selected for brief presentation 6 cases, which are illustrative of the various degrees of injury to the small intestine and colon.

CASE 3: A 29-year-old soldier noticed a swelling of the left testicle in March 1945. In October 1945, a radical left orchiectomy was performed and an ovoid mass 10 × 5 × 3 cm. was found adjacent to the aorta in the midline; it could not be resected. The histologic report was teratoma of the testis with embryonal adenocarcinomatous component. A total dose of 6,456 r was delivered to the mass in twenty-seven days.

Forty-five days later the patient began to vomit, and an upper gastro-intestinal series revealed prepyloric constriction and ulceration. One month after this there was massive hematemesis, and a subtotal gastric resection was performed. This aspect of the case has been previously reported (11). The patient made a good postoperative recovery and was able to return to work as a mechanic. In December 1947, two years after completion of therapy, there was onset of vomiting, diarrhea, and abdominal pain, with chills and fever. Jaundice appeared and persisted until death. Barium enema examination twenty-nine months after irradiation was completed revealed constriction of the lumen and thickening of the wall of the transverse colon (Fig. 1). The course was downhill and the patient died thirty-four months after completion of irradiation.

Autopsy failed to reveal any evidence of tumor, and the metastases noted at operation could not be found. There was extensive damage to the gastrointestinal tract. The ileum was thickened and its walls were edematous, with degeneration of the muscularis layer. There were multiple mucosal hemorrhages. The sigmoid showed degeneration and desquamation of the superficial mucosa. Perforation of the transverse colon, with matting of the large and small intestine near the porta hepatis, was found.

Comment: This case illustrates severe damage of the large and small intestine as well as of the stomach. Perforation of the colon was instrumental in causing death. It is particularly pertinent to emphasize that residual tumor was not found at autopsy though metastases had been encountered at operation thirty-four months previously. Despite the radiation damage, the therapy may have contributed materially to the prolonged survival after metastasis.

Fig. 2. Case 11. Persistently dilated gas-filled small intestinal segments, sixteen months after irradiation.

CASE 7: A 39-year-old officer noticed swelling of his left testicle in May 1945. In August 1945 a radical left orchiectomy was performed, and gross metastases were found in the para-aortic region from the renal pedicle to the bifurcation of the aorta. The histologic diagnosis was mixed teratoma with embryonal carcinomatous component. A depth dose of 6,226 r in sixty-one days was delivered.

After irradiation, the patient's health was good except for occasional diarrhea. Ten months after completion of radiation therapy he noticed tarry stools, but since he felt well he did not consider this important. One month later there was an acute onset of mid-epigastric pain with vomiting. Following lunch, the pain became more diffuse and vomiting continued. The center of the pain was located directly above the umbilicus in the mid-line. The next day the temperature was 101° F. Physical examination revealed moderate rigidity of the recti muscles and marked rebound tenderness over the entire abdomen. A perforation of the small bowel was suspected, and the patient was treated conservatively with antimicrobial therapy. He died sixteen days after onset of the acute pain.

Postmortem examination revealed densely adherent loops of ileum covered by omentum. Two perforations in the ileum, measuring 2 × 3 cm., were found. Histologic examination showed necrosis of the muscularis of the ileum in the area of the perforation. No evidence of metastatic lesions was found. The mucosa of the colon was not abnormal.

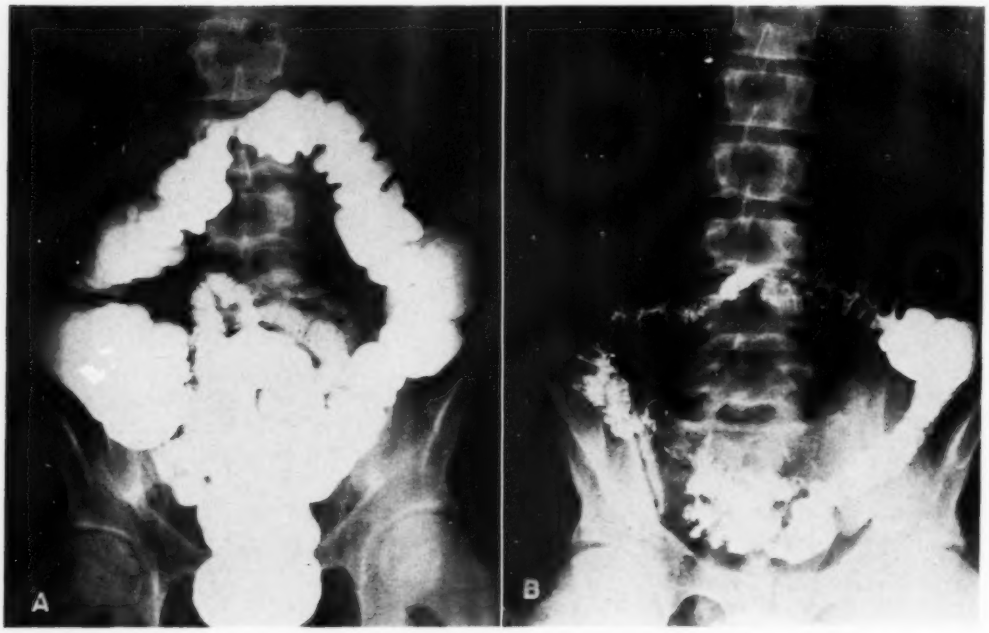


Fig. 3. Case 12. A. Stricture of the transverse colon and centripetal contraction of the colon. Contraction of the mesocolon. Twelve months after irradiation.
B. Retention in damaged transverse colon due to failure of muscularis. Note low position of hepatic and splenic flexures. Twelve months after irradiation.

Comment: This patient died eleven months after treatment because of a perforation of the ileum and generalized peritonitis. Metastases were known to be present prior to therapy but were not found at autopsy.

CASE 11: A 28-year-old soldier noticed soreness in his right testicle in October 1944. Seven days later a right simple orchiectomy was performed, and the histologic diagnosis of embryonal adenocarcinoma was made. Retroperitoneal nodes resected in November 1944 also revealed embryonal adenocarcinoma. A dose of 10,350 r was delivered in one hundred and twenty-six days. One year later inanition developed, with swelling of the abdomen and lower abdominal pain. A barium enema at this time revealed constriction and shortening of the small intestine, with dilatation of several loops (Fig. 2). The course thereafter was relentlessly downhill and death ensued twenty-three months after completion of therapy. Autopsy showed shortening of the mesocolon and mesentery, with matting of the small intestine and colon. No residual tumor was found.

Comment: This case illustrates again absence of metastatic tumor after irradiation which caused moderate small and large intestinal damage, with resulting inanition.

CASE 12: A 24-year-old soldier noticed swelling of his left testicle in July 1945. Orchiectomy was performed and the histologic diagnosis was embryonal carcinoma. A depth dose of 4,176 r was delivered in forty-seven days. Following irradiation, the patient was well for seven months, at the end of which time anorexia, nausea, and vomiting occurred. Diarrhea was noted eight months after completion of therapy. A barium enema revealed shortening of the colon and mesocolon, with constriction and ulceration of the mid-transverse colon (Fig. 3). The patient died thirteen months after completion of therapy and postmortem examination revealed extensive pulmonary metastases. The mid-transverse colon was markedly constricted, admitting only one finger through the lumen; the mucosa was dark red, with an old healed ulcer. There were no other areas of ulceration or constriction.

Comment: This case demonstrated localized damage to the mid-transverse colon in a patient who died with pulmonary metastases. The irradiation damage was not considered contributory to death.

CASE 13: A 34-year-old officer noticed enlargement of his right testicle in April 1945. Radical orchiectomy was done in July 1945, and no evidence of metastatic lesions was found. The histologic diagnosis was seminoma. The patient received a depth dose of 5,232 r in sixty days. To date he has had no symptoms. Gastro-intestinal examination as part of the routine follow-up study revealed only slight irritability of the transverse colon and evidence of some shortening of the mesocolon (Fig. 4). Normal small bowel was found.

Fig. 4. Case 13. Irritability of transverse colon, with elevation indicating contraction of transverse mesocolon, thirty-nine months after irradiation.

Comment: This patient is living and well after a large dose of x-ray therapy. While there are no gastro-intestinal symptoms, mild changes are demonstrable roentgenologically.

CASE 15: A 31-year-old soldier noticed an enlargement of the left testicle in January 1944. In October 1944 a simple orchiectomy was performed. Histologic examination revealed undifferentiated carcinoma. In November 1944, a radical resection of the retroperitoneal lymph nodes revealed gross metastases, confirmed histologically. The patient received a depth dose of 6,100 r to the retroperitoneal region in seventy-four days. Five months after treatment there were bloating, flatus, and some mucous discharge from the rectum. At eight months

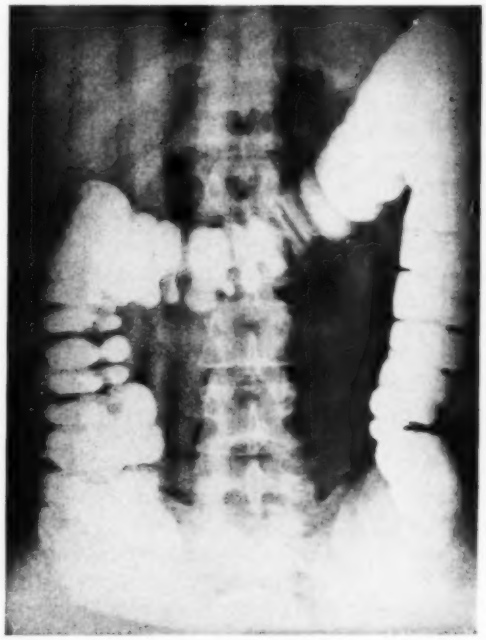


Fig. 5. Case 15. Slight irritability of transverse colon, thirty-two months after irradiation (6,527 r to mid-transverse colon in seventy-four days).

moderate diarrhea occurred, but the patient gained weight and has enjoyed fairly good health. He has only mild gastro-intestinal symptoms, consisting chiefly of slight distention fifty-one months after completion of radiation therapy. A barium enema revealed only moderate irritability of the mid-transverse colon (Fig. 5). The small bowel series showed no abnormality.

Comment: This patient, with retroperitoneal metastases, received a very large dose of radiation and is living and well fifty-one months after treatment, with mild gastro-intestinal symptoms and slight roentgenologic changes.

ROENTGEN FINDINGS

In cases of mild to moderate severity, barium enema examinations showed irritability, spasticity, and irregular haustral markings of the portion of the colon irradiated. In some of the cases the normal downward convexity of the transverse colon was reversed, so that the convexity was upward (Fig. 4). This finding was interpreted as a result of shortening of the transverse mesocolon. Several patients

showing the roentgen findings indicated are thus far without symptoms as long as four years following irradiation.

As the pathological process progressed, constriction with rigidity and fixation of the wall of the heavily irradiated portion of the colon was noted. The barium mixture was retained in the damaged segment because of its inability to contract (Figs. 1C and 3B). Centripetal contraction of the entire colon occurred frequently as a result of marked contraction of the mesocolon (Fig. 3). These latter roentgen findings have not previously been reported as a result of irradiation. Although ulceration and perforation were observed not infrequently in the pathological specimen, such lesions were not demonstrated roentgenologically.

Small intestinal changes were less striking than those in the colon, and the damage was less severe than had been anticipated. Fixation of loops of the small bowel, frequently present in carcinoma of the female pelvis, was not observed in this series. Lack of interference with normal motility may have afforded relative protection to the small intestine. Gross irregular deformity of intestinal loops, slight dilatation of the lumen, which frequently contained gas, and increased prominence of the valvulae conniventes were the radiological findings encountered (Fig. 2).

DISCUSSION

Fifteen cases in which irradiation damage to the small or large intestine was demonstrated either by roentgenologic findings or at postmortem, or both, have been presented. In 9 of these there was close correlation between the necropsy findings and the roentgen picture. Ulcerations and perforations of the involved colon, however, were not always demonstrated ante mortem. In 2 cases, perforation of the ileum occurred without involvement of the colon. More frequently there was serious damage of the colon without a corresponding degree of small intestinal injury.

Five other patients, who received depth doses of 1,000-kv. radiation in the same quantitative range as the 15 mentioned above, are living and without gastrointestinal symptoms after a period of time longer than the survival periods of the fatal cases (Table I).

Despite the fact that some patients can apparently survive a dose of supervoltage radiation which causes severe damage to the intestine and even death in other patients, we have attempted to determine a safe maximum dosage. It will be noted that in the group with severe damage the dose range was from 5,952 r in sixty-three days to 6,750 r in sixty-one days. In the group with moderate damage, the range was from 5,512 r in fifty-five days to 10,350 r in one hundred and twenty-six days. Mild damage, with apparently no handicap four years after irradiation, occurred in 4 patients receiving from 4,176 r in forty-seven days to 6,100 r in seventy-four days.

In view of these findings it is our opinion that a depth dose of 4,500 r of 1,000-kv. radiation can be delivered in fifty-four days into the abdomen through moderate-size portals with little likelihood of permanent small or large intestinal damage. In each of the 7 autopsied cases in which the damage of the bowel was the cause of death, or a major contributory factor, the dose was above 6,000 r. Further study of the 4 living and well patients who received over 6,000 r (and other living patients receiving similar quantities of supervoltage irradiation) is being performed. Although the condition of the living patients is static clinically and roentgenologically after four years, it is realized that further late changes due to irradiation may occur.

Despite the irreversible bowel damage in a few of the cases in which metastatic lymph nodes had been demonstrated, survival was undoubtedly prolonged. The authors are in agreement with Cosbie (9) and Cahill (12), who state, in effect, that in irradiating resistant neoplastic tumors which are beyond the scope of any other form of treatment, the risk of visceral

damage is justified and is comparable to justifiable surgical risks. The risk is slight when 4,500 r depth dose in fifty-four days is not exceeded, but when substantially larger dosage is necessary visceral damage must be anticipated.

When justifiable damage occurs, its early detection and prompt treatment will augment the benefit derived from the irradiation.

SUMMARY

A study of the effects of 1,000-kv. irradiation on the small and large intestine in a group of 20 patients is reported. As contrasted to previous similar reports, the present study is unique in that the patients were male, the disease for which they were being treated (testicular tumor with or without retroperitoneal lymph node metastases) does not affect the intestine, and only external 1,000-kv. radiation was used.

Damage of varying degree to the small and large intestine occurred in some patients receiving large doses of such radiation into the abdomen. Correlation of roentgenologic findings and autopsy results is presented.

Though great individual variation is shown in a study of the cases, it is believed that the small and large intestine of the adult male can tolerate 4,500 r of 1,000-kv. irradiation administered in fifty-four days without deleterious results.

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SUMARIO

Lesiones Irradiatorias de los Intestinos a Continuación de una Roentgenoterapia de 1,000 kv. Valuación de la Dosis de Tolerancia

Este estudio de los efectos de una irradiación de 1,000 kv. en el intestino delgado y el grueso fué ejecutado en un grupo de 20 enfermos. En contraposición a previos estudios semejantes, el estudio actual resulta único en su género, por ser todos los pacientes varones, no afectar el intestino la enfermedad por la que se les trataba (tumor testicular con o sin metástasis en los ganglios linfáticos retroperitoneales) y sólo haberse usado irradiación externa de 1,000 kv.

En algunos enfermos que recibieron grandes dosis de dicha irradiación en el abdomen hubo lesiones más o menos graves en los intestinos delgado y grueso. Se presenta una correlación de los hallazgos radiográficos y los resultados de la autopsia.

Aunque el estudio de los casos revela mucha variación individual, parece que los intestinos delgado y grueso de los varones adultos pueden tolerar sin efectos adversos una dosis de 4,500 r de irradiación de 1,000 kv. administrada en un período de cincuenta y cuatro días.

Symptomatic Hemangioma of the Spine[1]

HARRY J. MANNING, M.D.

HEMANGIOMA OF the vertebra, which in most instances is encountered as an incidental roentgen finding, becomes a lesion of prime importance when it is associated with compression of the spinal cord. Although such lesions had undoubtedly been recognized much earlier, Virchow was the first to report the presence of a vertebral hemangioma in 1863. Probably the first description of associated neurologic manifestations was presented by Gerhardt (Germany) in 1895 (8). It was not until 1926, however, that the presently accepted characteristic roentgenographic features of the lesion were brought to our attention by Perman (11). Until that time only 8 cases of vertebral hemangioma associated with compression myelopathy had been reported, the diagnosis having invariably been made at autopsy. Since then, numerous cases have appeared in the literature.

Bailey and Bucy (1), in 1929, were the first in this country to report a case of hemangioma of the vertebra associated with compression of the spinal cord. Treatment consisted in laminectomy followed by roentgen irradiation. Schlezinger and Ungar (11), in 1939, were among the first Americans to emphasize the unquestionable value of the roentgen rays in the primary treatment of hemangioma of the vertebra with secondary compression myelopathy. In cases manifesting marked compression of the spinal cord and in rapidly progressing compression myelopathies, they advocated surgical intervention (laminectomy) followed by irradiation. In 1941 Ghormley and Adson (8), in an analysis of 39 cases of hemangioma of the vertebra associated with neurologic disturbances of varying degree, concluded that in patients with paraplegia, decompressive laminectomy with postoperative roentgen therapy produced the best clinical response; whereas in patients who exhibited local symptoms or evidence of compression myelopathy, without the presence of paraplegia, irradiation was the procedure of choice.

Ferber and Lampe (5), in 1942, reported a case of hemangioma of the seventh thoracic vertebra with compression of the spinal cord in which roentgen therapy was the sole method of treatment. Almost complete recovery resulted. They cited 12 cases from the literature in which roentgen therapy alone was used, with complete clinical recovery in the majority and marked improvement in the remainder.

Kaplan (9) in 1946 stated that irradiation may be expected to effect a cure in hemangioma of the vertebra (with spinal cord compression) if the diagnosis is made before irreparable damage to the cord has taken place. He supported this observation with the report of a case associated with extensive spinal cord compression in a 12-year-old boy, in which a complete cure was effected following postoperative roentgen therapy. A case of epidural hemangioma associated with vertebral hemangioma and spinal cord compression, in which complete clinical improvement was obtained with x-ray therapy alone, was also reported by Foster and Heublein (6).

CASE REPORTS

The following cases of symptomatic hemangioma of the spine were successfully treated in the Radiation Therapy Department of Bellevue Hospital. One other case from the same institution has previously been reported by Kaplan.

CASE 1: M. C., a 57-year-old white female, was first seen in the Radiation Therapy Clinic on July 25, 1940. In 1938 she had experienced a sudden pain in the left metatarsal arch accompanied by a feeling of nausea. The symptoms disappeared in a

[1] From the Radiation Therapy Department, Ira I. Kaplan, M.D., Director, Bellevue Hospital, New York University College of Medicine, New York, N. Y. Accepted for publication in May 1950.

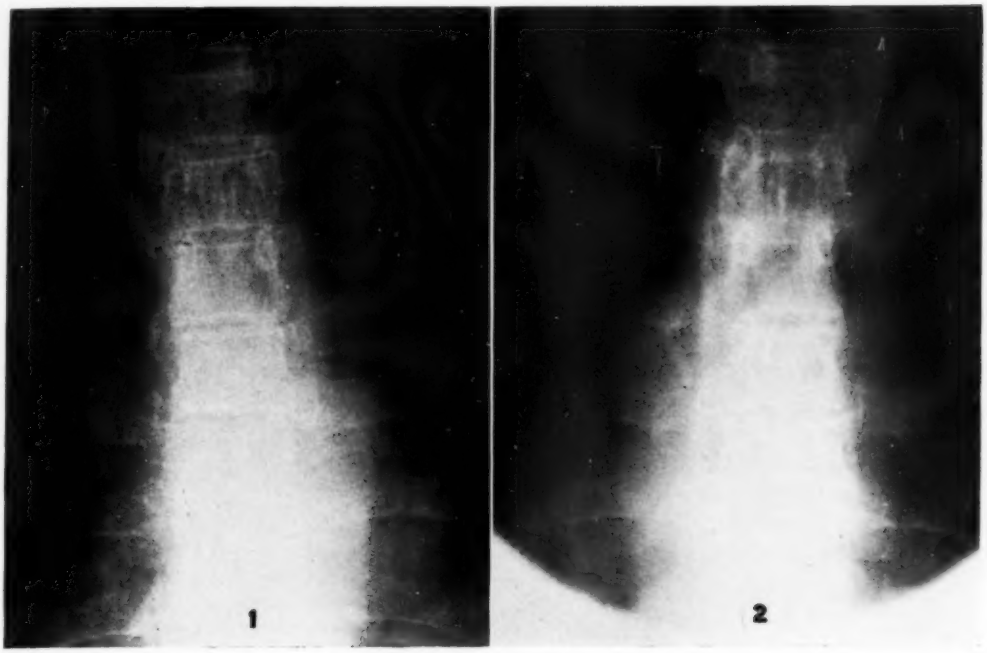

Fig. 1. Case 1. Hemangioma of the fourth thoracic vertebra before institution of roentgen therapy (post-laminectomy).

Fig. 2. Case 1. No change in lesion noted nine and a half years after roentgen therapy, although clinical recovery was obtained.

few hours and were almost forgotten by the patient during the course of the next year. One year prior to her admission to the Neurological Service of Bellevue Hospital on June 23, 1940, a sensation of "pins and needles" in both heels had developed and the gait had become unsteady. These symptoms persisted, and in the interval before admission, a sensation of pressure in the lower back and abdomen, a girdle sensation in both thighs, and urinary incontinence occurred.

Physical examination on June 23, 1940, revealed positive findings referable to the nervous system. The patient walked with a spastic, staggering gait; both lower limbs showed a marked defect in position and joint sense, involving the ankles and knees as well as the toes; vibratory sense was practically lost from the ilia down; pin-prick and temperature sensations showed a defect reaching as high as D-5 on both sides; and there was no tenderness of the vertebral spine. In the lower limbs the deep reflexes were hyperactive, and a positive Babinski was present bilaterally. Abdominal reflexes were absent. The cranial nerves were intact. The fundi were normal. Spinal tap indicated cord block, and radiographic examination of the thoracic spine showed osseous changes in the body of D-4 which were suggestive of hemangioma (Fig. 1). A chest film was negative.

In view of the neurological findings, which pointed to an extramedullary lesion in the upper thoracic spine, and because of the changes in the body of D-4 as seen on the roentgenogram, a laminectomy of D-3 to D-5 inclusive was performed on July 2, 1940. At operation, a very vascular tumor involving the vertebra was discovered. The pathological report on the biopsy specimen substantiated the roentgen diagnosis of "hemangioma."

Since no appreciable improvement was noted three weeks postoperatively, the patient was referred for irradiation, with the express purpose of preventing further progress of the disease, if possible. Deep x-ray therapy was instituted on July 25, 1940, with the following factors: 200 kv., 20 ma., 50 cm. focal skin distance, filtration 0.5 mm. Cu and 1 mm. Al. A daily air dose of 150 r was given through a single 8 × 10-cm. posterior field directly over the lesion, until a total amount of 1,050 r (measured in air) had been administered. This course of treatment was completed on Aug. 9.

Some clinical improvement was noticed as early as ten days after the beginning of radiation therapy. The patient had greater freedom of movement of the lower extremities, and bladder function showed considerable improvement. Neurological re-evaluation on Aug. 17, 1940 (three weeks after institution of radiation therapy) showed almost complete sensory improvement. The abdominal reflexes were present

Fig. 3. Case 1. Hemangioma of third lumbar vertebra, the second of two such lesions in the same patient treated successfully with roentgen irradiation.

and active. Deep tendon reflexes were still hyperactive, and both legs still showed spasticity.

Between Sept. 3 and Sept. 23, 1940, a second course of radiation therapy was given to the same area, with the same factors as in the previous treatment. A total of 1,500 r (measured in air) was given. Within four months after the last treatment there was almost complete recovery, except for slight residual weakness of the muscles of both legs.

The patient was not seen again in our Clinic until Jan. 9, 1948, when she came in complaining of low back pain and a slight aching sensation over the previously treated upper thoracic spine. X-ray examination of the lumbar spine showed an hemangioma of L-3 (Fig. 3). A course of radiation therapy (1,500 r, measured in air) was given through a single 10 × 15-cm. portal, with the method previously outlined. The low back pain subsided gradually, and within one month after the beginning of therapy there was complete relief of the symptoms.

Roentgenographic examination of the dorsal spine at this time showed no change in the appearance of D-4 from that noted in 1940.

The patient has been subsequently followed at more frequent intervals. When she was last seen at our Clinic, on Jan. 25, 1950, her only complaint was stiffness and slight soreness over the operative site in the upper thoracic spine. These symptoms were somewhat relieved by a corset. There was no recurrence of symptoms over the lumbar spine and lower extremities.

Follow-up x-ray study of the spine showed no change in either of the described lesions (Fig. 2).

Comment: This case is of particular interest in that two separate lesions, diagnosed eight years apart, were successfully treated by irradiation.

CASE 2: J. R., a 56-year-old colored female, was seen in the Radiation Therapy Clinic on March 29, 1944, complaining of "pain in the back, on the right side." The patient said her illness dated back a year, when she twisted her right foot while walking and felt a sudden sharp pain in the right hip radiating to the lower back. The pain persisted, and efforts to obtain relief with various prescribed remedies failed. Finally, a roentgenogram of the spine was made at another hospital, and "hemangioma of the fourth lumbar vertebra" was discovered. The patient was then referred to Bellevue Hospital for radiation therapy.

Physical examination just prior to beginning of treatment revealed exquisite tenderness over the spinous processes of L-3 to L-5 inclusive, but no objective neurologic disturbances were noted. Radiographic examination of the lumbar spine showed an osseous lesion of the body of L-4 which was characteristic of hemangioma. There was no collapse of the vertebra (Fig. 4).

The patient received a course of deep x-ray therapy between April 3 and May 1, 1944. At each treatment a dose of 300 r (measured in air) was given through two 8 × 10-cm. posterior paravertebral ports, directed to L-4, until a total dose of 3,000 r (measured in air) was administered to each port. One area was treated daily, and the factors were 200 kv.; 20 ma.; 50 cm. distance; filter, 0.5 mm. Cu and 1 mm. Al.

Because her back pain was not completely relieved following the first course of irradiation, the patient was given another series of treatments between Sept. 15 and Oct. 30, 1944. A total dose of 1,500 r (measured in air) was given through each of the same two fields.

At this time telangiectasia developed over the treated skin areas, precluding further irradiation, in spite of the persistence of some pain at the site. A supportive brace seemed to produce some relief.

The residual pain gradually became less intense over a period of time, and when the patient was seen in our Clinic on Jan. 25, 1950, she was entirely comfortable.

Roentgen re-examination of the lumbar spine during the last visit (Jan. 26, 1950) showed no apparent change in the appearance of the lesion (Fig. 5).

Comment: Although the response to treatment in this case was delayed, and the

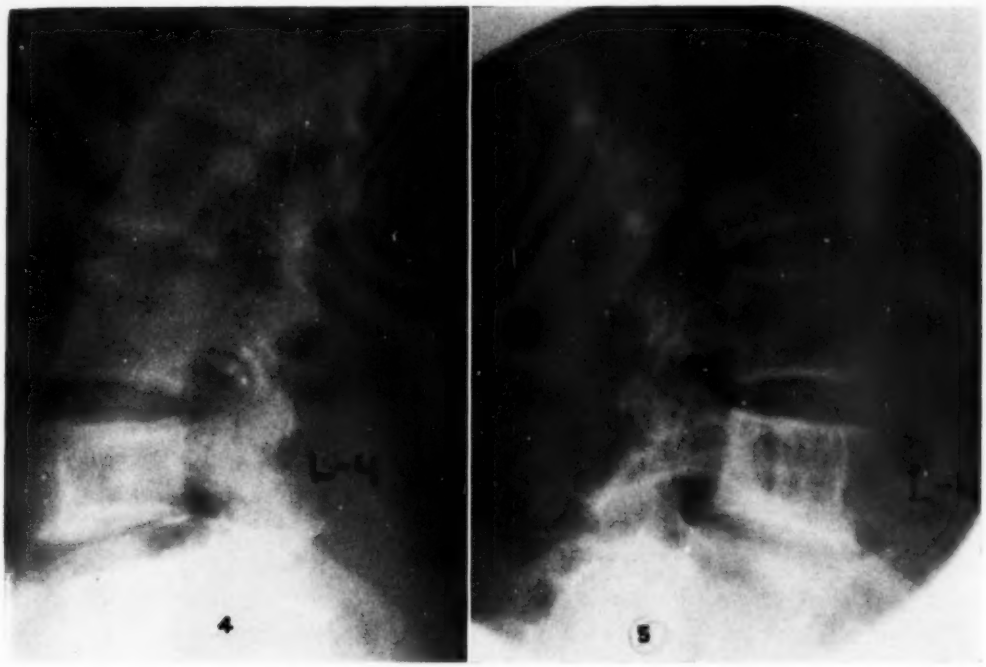

Fig. 4. Case 2. Hemangioma of fourth lumbar vertebra, before treatment.
Fig. 5. Case 2. No remarkable change in lesion nearly six years after roentgen therapy. Clinical improvement following treatment.

results achieved were less spectacular than in the other two cases, radiation therapy was successful in bringing about relief.

CASE 3: R. S., a 50-year-old white female, was first seen in the Radiation Clinic on May 16, 1944, at which time she complained of pain in the back. Two months before, while bending forward, she had experienced a sudden severe pain in the mid-spine. The pain subsided after several days rest in bed but recurred under similar circumstances one month later; this time it was accompanied by a "weakness" of both legs.

No positive abnormal findings were elicited on complete physical examination. A roentgenogram of the spine showed "changes in D-12 suggestive of hemangioma, without collapse of the body" (Fig. 6).

X-ray therapy was started on May 17, 1944, but after a few days of treatment the patient failed to return and was not seen again until two years later, on Feb. 18, 1946. At this time she had severe pain over the coccyx, radiating down the left thigh. This pain had been present during the past year and a half. Physical examination was again negative. A roentgenogram of the spine showed the same findings which had been reported previously.

Deep x-ray therapy was reinstituted on Feb. 18, 1946, 300 r (measured in air) being given to each of two 6 × 15-cm. right and left posterior paravertebral ports, directed to the lesion. One area was treated daily until a total dose of 3,000 r (measured in air) had been given through each portal. This constituted a calculated depth dose of 3,500 r.

The response was almost dramatic, and within three weeks of the institution of treatment (and one week before its completion) the patient was symptom-free.

During a periodic check-up on June 14, 1946, roentgenograms of the spine showed beginning calcification of the body of D-12. In spite of the complete symptomatic improvement, it was decided to attempt to sclerose the lesion further with additional deep irradiation, and between June 24 and July 16, 1946, a total of 3,000 r (measured in air) was given through a single 10 × 15 cm. posterior midline port. The same factors were used as in the two previous cases, and a daily air dose of 200 r was employed.

The patient has remained relieved since then and was symptom-free on her last visit to the Radiation Department, Jan. 25, 1950. At that time she was completely well and complained only of "red marks on my back" (post-irradiation telangiectasia). Roentgenograms of the spine showed no change from the previous examination (Fig. 7).

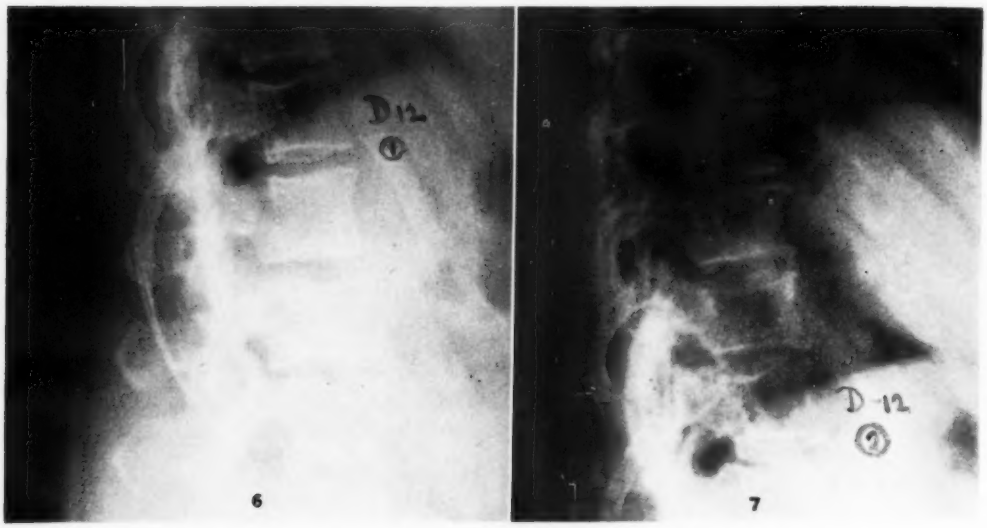

Fig. 6. Case 3. Hemangioma of the twelfth thoracic vertebra, before roentgen therapy.
Fig. 7. Case 3. Increased calcification of the lesion following roentgen therapy.

Comment: This case illustrates the progression of neurological symptoms in an untreated patient, with prompt response to irradiation at a later date.

DISCUSSION

Incidence: In a routine study of 3,829 spinal columns at necropsy, Schmorl (8) found hemangioma in 10.7 per cent of the cases. The incidence was somewhat greater in females, being 12.5 per cent as compared with 8.9 per cent for males. These angiomas were for the most part incidental findings, having given no hint of their presence prior to autopsy examination. Schmorl noted that the frequency of these lesions increased with advancing age, and he concluded that they either tended to develop with age, or, if present at birth, increased in size later in life. Coley (3) believes that the idea of a higher incidence with advancing years may be misleading, since the condition is only infrequently discovered during life. In spite of the relatively low incidence (less than 5 per cent) of hemangioma of the vertebra in persons under thirty years of age, 50 per cent of such lesions, when they are accompanied by neurological symptoms and signs, occur in this lower age group.

Anatomical Distribution: According to Ghormley and Adson, the most frequent sites for vertebral hemangioma are between D-12 and L-4, inclusive. Schlezinger and Ungar stated that, despite the more frequent general distribution of hemangiomas in the lower thoracic and upper lumbar vertebrae, these lesions, when they are associated with neurologic manifestations, seem to show a predilection for the mid-thoracic vertebrae (T-3 to T-8). They explain this phenomenon on an anatomical basis; namely, that the spinal canal is narrowest at the mid-thoracic level of the spine, and consequently the spinal cord can more easily be encroached upon by an extramedullary lesion.

Pathogenesis: Ewing (4) writes that compression myelitis, which in rare instances accompanies hemangioma of the vertebra, is due to slow collapse of the body of the vertebra. This may hold true in certain cases. It is generally accepted, however, that collapse of an hemangiomatous vertebral body is an exceedingly rare occurrence. Therefore, other factors must

be taken into account in attempting to explain the mechanism of compression myelopathy resulting from hemangioma of the vertebra.

Schlezinger and Ungar, who have carefully investigated this aspect of the disease, give a possible explanation for the occurrence of spinal cord compression. They state that studies of asymptomatic vertebral hemangiomata reveal the highest prevalence of involvement in the bodies of the vertebrae. On the other hand, in cases with neurologic findings, there is definitely a higher incidence of associated involvement of other parts of the vertebra (spinous processes, laminae, pedicles). However, compression of the spinal cord is not to be explained wholly by the extensive involvement of a vertebra with hemangioma, since cases have been described in which the entire vertebral segment has been involved by the tumor without any signs of cord compression.

The phenomenon of "ballooning" of the vertebra in some cases of hemangioma, originally described by Makrykostas (10) in 1927, may account for some cases of compression myelopathy. This consists of a partial rounding out of the concave vertebral borders as a result of secondary pathological changes (edema, thrombosis, etc.) within the body of the vertebra; this may result in encroachment upon the spinal canal. Several authors have also shown the relationship between an epidural hemangiomatous involvement and compression of the spinal cord. This, however, is not a common occurrence.

Diagnosis: Most cases of hemangioma of the vertebra present no clinical symptoms and, as pointed out above, are discovered accidentally on roentgenograms of the spine or at autopsy. The remaining cases show a wide range of symptoms referable to the spinal cord and corresponding to the cord level of the osseous lesion, all the way from mild local pain and tenderness over the spine to paraplegia and sphincteric incontinence. Progression of symptoms may be slow or extremely rapid, and remissions are of frequent occurrence.

The extent of positive neurologic signs depends upon the degree of spinal cord compression or damage. The earlier findings are generally those referable to the dorsal and lateral columns of the spinal cord, manifested by spasticity and paresis of the lower extremities associated with ataxia. Paraplegia and loss of sphincter control are late manifestations.

Spinal fluid examination is the only laboratory test of any diagnostic value, although early in the disease no abnormal findings may be present. With compression of the spinal cord, the spinal fluid may show a xanthochromia and an increase in protein; a positive Queckenstedt sign can usually be demonstrated.

Of greatest diagnostic value is a roentgenogram of the indicated region of the spine. Where the entire body of the vertebra is involved with hemangioma, the roentgenographic findings are usually quite typical. Bailey and Bucy's original description of the roentgenologic features of hemangioma of the vertebra as "the picture of reduction in bone density between parallel vertical trabeculae which are increased in density" still holds. A partly calcified lesion may simulate Paget's disease; however, the latter can usually be ruled out by further skeletal survey and by alkaline phosphatase determination. Hodgkin's disease, myeloma, and chordoma must also be taken into consideration in the differential diagnosis.

Treatment: Prior to the almost general acceptance of roentgen therapy as the primary form of treatment for symptomatic hemangioma of the vertebra, surgery (laminectomy) alone or surgery followed by roentgen therapy was the usual method of treatment. Because of the inherent vascularity of the tumor, the operative mortality was high (20 to 25 per cent) as a result of uncontrollable bleeding. Not only did most of the surviving patients go through a hectic postoperative course, but some were not at all benefited by the operation.

The foremost early objection to the use of roentgen rays in the treatment of this lesion was that there was too much delay

in relieving the compression of the cord and that further damage might then result. This assumption has not been substantiated, however, by the reports of many authors (Ferber and Lampe, 5; Schlezinger and Ungar, 11; Kaplan, 9; Foster and Heublein, 6; and Blackford, 2), who have described excellent clinical results with irradiation. Most writers agree that laminectomy should be performed for decompression in the rare cases of sudden spinal cord compression secondary to this lesion.

It must be reiterated that, in spite of excellent results obtained with roentgen therapy in the treatment of hemangioma of the vertebra associated with spinal cord compression, no recovery or improvement can be expected if irreversible damage has been done to the cord. In such cases, treatment of any sort is of no avail.

It might be mentioned that the roentgenographic picture changes little, if at all, following x-ray therapy. Occasionally, calcification of the lesion may occur.

SUMMARY AND CONCLUSIONS

1. Hemangioma of the vertebra has been found in approximately 10 per cent of routine autopsy examinations of spinal columns. Roentgenographically, it is usually an incidental finding with no previous warning signs or symptoms.

2. When accompanied by symptoms, hemangioma of the vertebra requires treatment. Irradiation is now almost generally accepted as the primary form of therapy in such cases, though surgery may be necessary in event of sudden spinal cord compression by the tumor. Radiation therapy should always follow the laminectomy.

3. Three cases of hemangioma of the vertebra associated with neurologic manifestations of varying degree are presented, which responded satisfactorily to radiation therapy.

4. The effective dosage of roentgen rays varies in quantity from patient to patient and is determined by the individual clinical response. Repeated courses of irradiation are usually necessary to effect recovery or improvement.

5. Diagnosis is made chiefly from the roentgenographic appearance of the lesion.

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SUMARIO

Hemangioma Sintomático del Raquis

El hemangioma vertebral ha sido observado aproximadamente en 10 por ciento de los exámenes autópsicos corrientes de las espinas dorsales. Radiográficamente, suele ser un hallazgo incidental sin previos signos o síntomas que pongan sobre aviso.

Si va acompañado de síntomas, el hemangioma vertebral exige tratamiento.

La irradiación está hoy día generalmente aceptada como la forma primordial de terapéutica en esos casos, aunque puede necesitarse la intervención cruenta en caso de súbita compresión de la médula espinal por el tumor. La radioterapia debe seguir siempre a la laminectomía.

Preséntanse 3 casos de hemangioma de las vértebras, asociados con manifestaciones neurológicas más o menos intensas, todos los cuales respondieron satisfactoriamente a la radioterapia.

La dosis eficaz de rayos X varía en cantidad de enfermo en enfermo, determinándola la respuesta clínica del individuo dado. Suelen necesitarse series repetidas de irradiación para lograr la curación o mejoría.

El diagnóstico se basa principalmente en el aspecto radiográfico de la lesión.

The Inverted Position in Roentgenography[1]

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THE IDEA OF PARTIALLY inverting the patient for various radiologic examinations is, of course, an old one. The Trendelenburg position is utilized routinely in hysterosalpingography, and cephalad tilting in myelography. The head is turned vertex down for views in encephalography and ventriculography. Inverting of the patient is logically suggested for study of the air column in a condition such as imperforate anus.

This maneuver, however, does not seem to be widely employed in a number of routine x-ray examinations in which our experience has shown it to be of value. This is especially true for visualization of portions of the alimentary canal and of the urinary tract. We have found the inverted position to be superior to any other for gaining information about troublesome areas, such as the lower esophagus and the sigmoid. It is an excellent aid for concentrating the contrast medium when recording images of the renal pelves during intravenous pyelography.

APPARATUS

The apparatus we employ to maintain the patient in an inverted position is shown in Figures 1 and 2. It consists of a special suspension garment, worn by the patient, that is attached to a revolvable aluminum plate. This, in turn, is fastened to a bracket attached at an angle of 90 degrees to the foot of a tilt-type x-ray table.

The patient first dons a suitably designed shoulder pad to render more comfortable the pull of the suspension garment when he is inverted. The suspension garment itself is made of flexible material, such as canvas, with openings for the head and arms. Below the level of the armpits, the garment consists of side pieces in the midportions of which buckle-and-strap combinations permit adjustment to the patient's length. The ends of the side pieces are attached by clips to eye-bolts inserted into slots in the revolvable plate. Other straps also may be wound around the ankles and fastened to the eye-bolts. These straps, however, are rarely needed except in inverted positions approaching 90 degrees.

The plate revolves on an axle that is inserted into the bracket. The axle is aligned in the long center axis of the x-ray table at a level about 5 inches above the table top (Fig. 2).

This garment-revolvable plate arrangement permits easy fluoroscopic and radiographic examination of inverted patients in anteroposterior, lateral, and any desired oblique projections.

INDICATIONS AND EXAMINING PROCEDURE

Alimentary Canal

During fluoroscopy of the esophagus and stomach, a decision is made whether to record the image of the contrast medium in these structures with the patient inverted. A similar decision about the small intestine, especially the terminal ileum, is made subsequently in the light of fluoroscopic or routine roentgenographic findings in these areas. Whether or not the patient is inverted for radiography of the rectum, sigmoid, and colon also depends on the evidence supplied by the gastro-intestinal examination or by the barium enema study.

Although inversion is basically a supplementary procedure, the fact is that we are finding its use increasingly valuable for investigation of the esophagus, ampulla, gastric cardia, terminal ileum, transverse colon, colonic flexures, sigmoid, and rectum. For this reason, we have the patient

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Fig. 1. Patient in suspension garment on tilt-type x-ray table inverted 50 degrees. Note shoulder pad, open construction of garment anteriorly (and posteriorly), buckle-and-strap combinations for adjusting length of patient to table, and manner in which suspension garment is fastened to eye-bolts in circular plate at end of table.

don the suspension garment prior to fluoroscopy and routine radiography. He is then ready for examination in the inverted position whenever it is desired to employ the procedure. As shown in Figure 1, no part of the suspension garment can interfere with routine fluoroscopy or roentgenography of the abdomen or chest.

As to the degree of inversion, we have made numerous trials of cephalad tilts at

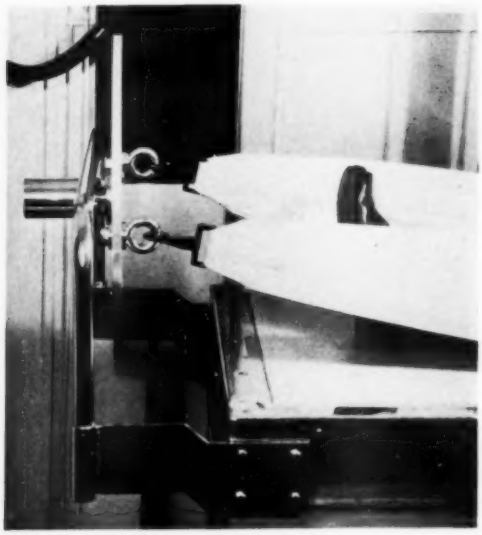

Fig. 2. Some details of circular plate revolving on an axle that is fastened to the bracket at the end of the x-ray table.

angles of 35 to 90 degrees below the horizontal, and find 50 degrees suitable for most examinations.

Esophagus: The patient is first given a drink of thin suspension of barium sulfate, and its passage through the esophagus is visualized with the patient recumbent. If there are indications of diverticulum, tumor, or other abnormality, the patient is inverted and given a second drink of the thin barium suspension. We then observe that the usually rapid peristalsis is markedly decelerated, even beyond that which occurs when the patient is changed from the erect position to the horizontal. The waves become so "lazy" that there is no difficulty in viewing the entire esophagus more or less at leisure. The long rugal markings, and other details, can be carefully examined. As the barium suspension moves "uphill" through the esophagus, a good-sized esophageal ampulla, just proximal to the gastric cardia, may be demonstrated in almost all patients.

In order to accentuate dilatation of the esophagus and ampulla, a thick mixture of barium sulfate and corn syrup is next administered. This flows slowly up the in-

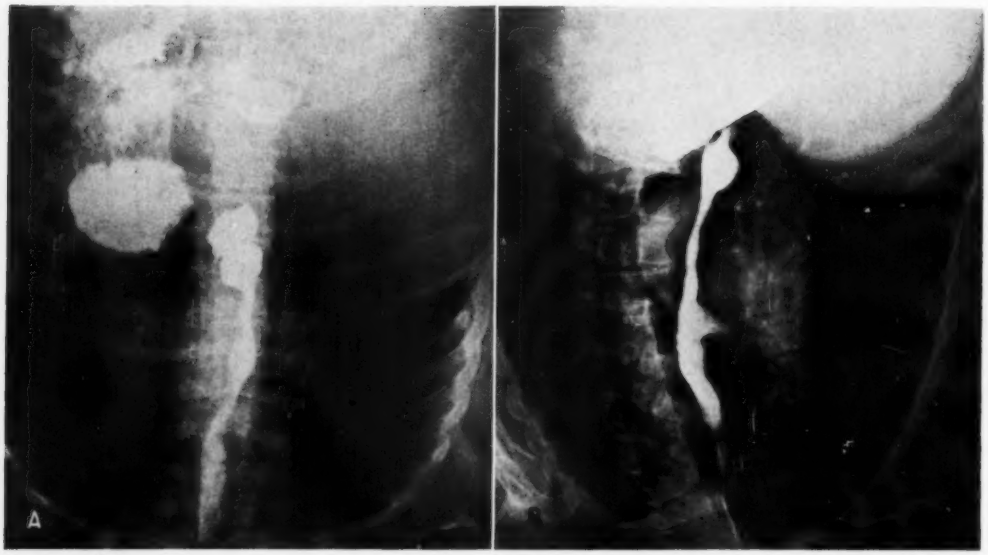

Fig. 3. Roentgenograms of esophagus in patients inverted 50 degrees. A. Esophageal ampulla and small hiatus hernia. Note appearance of rugal markings. B. Pulsion diverticulum and esophageal ampulla. C. Carcinoma of esophagus.

verted esophagus to the ampulla, dilatation of which is maintained for longer periods and to a greater extent than when the patient is either horizontal or erect.

Roentgenograms are made to record any abnormal findings in the esophagus, and usually the images of the ampulla and structures immediately distal to it. Typical anteroposterior and oblique views from patients in inverted positions are shown in Figure 3.

Stomach: When the patient is inverted for fluoroscopic or radiographic examination of the stomach, the first finding is that the gas bubble normally present in the cardia rises to a position in the prepyloric region and cap. Its presence here can be usefully employed during fluoroscopy to show the duodenal cap, which usually remains relatively static when there is air in it in this position. The use of the inverted position simplifies differentiation between the hiatus hernia and esophageal ampulla. When the contrast medium passes into the gastric cardia, the peripheral limits of this structure are easily delineated (Fig. 4). If a hiatus hernia is present, the radiopaque material readily gravitates into it and remains there until the patient is returned to a drainage position.

Small Intestine: During barium enema studies of inverted patients in which reflux of radiopaque medium has occurred, we have noted that some show loops of ileum free and discrete, while in others there is a reflux of the contrast substance into the ileum without separation of the

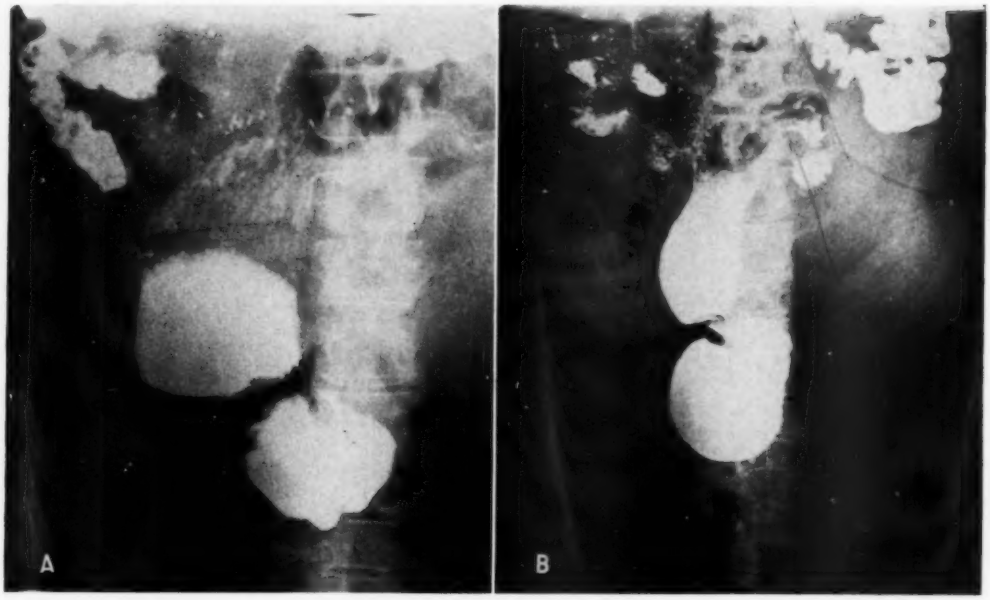

Fig. 4. Roentgenograms of stomach in patients inverted 50 degrees. A. Large esophageal ampulla and gastric cardia. B. Large hiatus hernia.

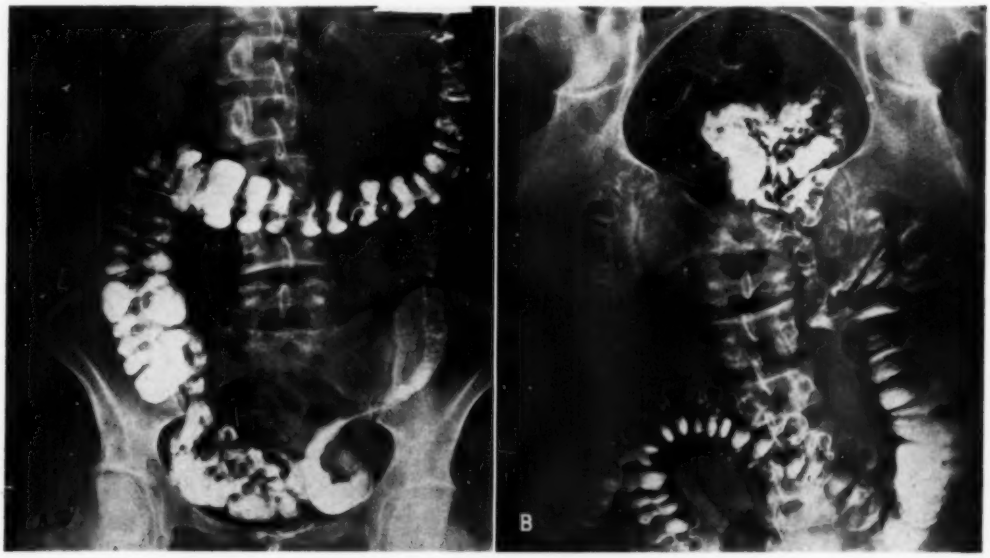

Fig. 5. Comparison roentgenograms showing appearance of colon during air-contrast study. A. Patient semi-erect. B. Patient inverted 50 degrees. Note visualization of rectum, sigmoid and cecum, and altered relations of other colonic structures when compared with Fig. 3A.

loops. These latter loops remain matted in close apposition, do not fall toward the diaphragm, and do not show the uniform lumens seen when the loops are free. This suggests the possibility of obtaining additional information in cases of regional

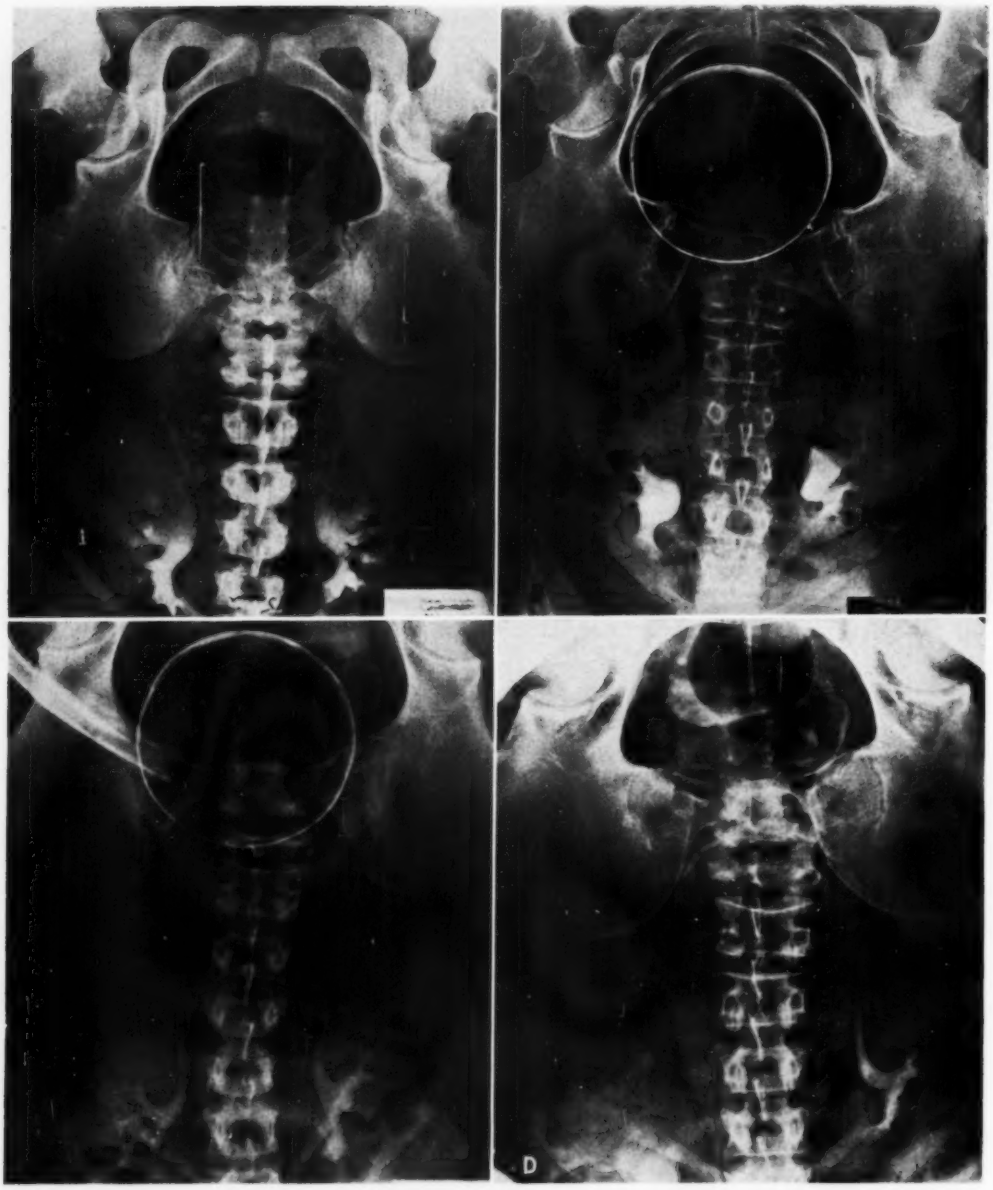

Fig. 6. Intravenous pyelograms of patients inverted 50 degrees. A. Pyelogram showing density of contrast medium in kidney pelves and upper portions of ureters. B. Pyelogram made with compression by means of balsa-wood button. C. Pyelogram made following intramuscular injection of diodrast. D. Pyelogram made with Foley bag catheter in rectum. Note visualization of lower portion of ureters.

ileitis or other conditions in which there are adhesions between the loops.

Colon: When, during a barium-enema examination, air-contrast study is indicated, the enema is expelled and the colon is insufflated with air. The first roentgenogram is made with the patient semierect at an angle of 45 degrees. In this

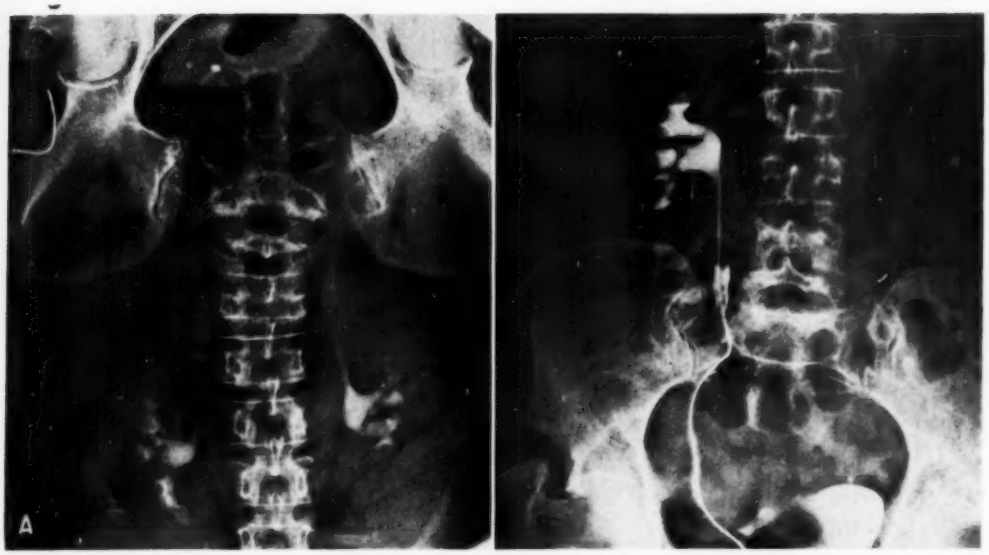

Fig. 7. Comparison pyelograms showing pedunculated polyp in right ureter. A. Intravenous pyelogram with patient inverted 50 degrees. B. Retrograde pyelogram.

position, the air distends the splenic flexure, the transverse colon, and the hepatic flexure. Next, the patient is inverted, and air is seen to be trapped in the ascending and descending portions of the colon, distending them well. The sigmoid and its mesentery fall over and act as a check valve, retaining air in the descending colon. The cecum, sigmoid, and rectum are clearly visualized. Many of these details are clearly demonstrated in the comparison roentgenograms reproduced as Figure 5.

Urinary Tract

For intravenous pyelography also, the patient first dons the suspension garment to be ready for inversion at the appropriate time. Next, a preliminary anteroposterior radiograph is made in the horizontal position. Following this, the patient is tested and questioned to eliminate the possibility of allergic response to diodrast. If no allergy is suspected, 20 c.c. of diodrast are injected intravenously, and the patient is inverted 50 degrees. The second radiograph is made five minutes later. The third film is exposed fifteen minutes after injection of the contrast medium. Just after the five-minute film, a 5-inch button of balsa wood is pressed on the abdomen between the iliac wings by a compression belt, or a Foley bag catheter is introduced into the rectum and the bag distended with about 200 c.c. of air (Fig. 6). Immediately after the third roentgenogram is made, the patient is returned to the erect position, compression or bag is removed, and a fourth film is exposed.

The use of the inverted position provides at least two advantages in the intravenous pyelographic examination. The images of the renal pelves and upper ureters are considerably intensified as compared with intravenous pyelograms made in the horizontal position. In many instances, the images have a brightness approaching that characteristic of retrograde pyelograms (Fig. 7). When intravenous pyelograms made with the patient inverted are compared with those made in the erect position, an excellent opportunity is presented to estimate the range of mobility of the kidneys and ureters, and the ability of the kidneys to empty. We have tried various combinations of inversion, including inversion with external compression and with the Foley catheter. It is our impression

that the combination of inversion and the Foley catheter permits demonstration of the fullest and densest kidney and ureter images. Often the ureter is clearly shown from the kidney to the bladder.

CONTRAINDICATIONS

When we first began to employ the inverted position, we were conscious of deleterious effects that seemed to be at least theoretically possible. We proceeded cautiously, therefore, especially with hypertensive patients, those with heart difficulties, and the aged or obese. Wide experience has shown, however, that with ambulatory patients, such as are examined in our practice, there is no cause for alarm. We have not been dealing with patients with decompensated heart lesions or with asthma. The suspension garment is relatively comfortable, and we have not found it necessary to discontinue the examination because of any distress. Some patients did show flushing of the face and distention of the superficial vessels of the head. None complained of dyspnea, although most were inverted from fifteen to thirty minutes.

VIEWING

The rule of viewing the roentgenograms in the position in which the patient is examined is a good one to follow. Thus, for anteroposterior projections with the patient inverted, the roentgenogram will be upside down on the illuminator, with the right side at the viewer's right.

SUMMARY

The apparatus, indications, and examining procedure are presented for the radiography of patients in a position of 50 degree inversion below the horizontal. The value of this technic in fluoroscopy and radiography of the alimentary canal, and in intravenous pyelography, is discussed. The appearance of the images of the esophagus, stomach, small intestines, colon, rectum, kidney, pelves, and ureters are briefly described. Conclusions as to contraindications with ambulatory patients are presented.

Our experience with the inverted position indicates that there are other examinations from which useful information also may be elicited. These include hysterosalpingography, outlining of the birth canal with relatively radiopaque balloons, the use of relatively radiopaque distensible tubes in the rectum and sigmoid for diagnostic purposes, lipiodol examination of the upper lobes of the lungs, and use of the body weight to produce the vacuum effect in the knee joints. Experiments are planned, or are under way, to prove the feasibility of these technics.

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SUMARIO

La Posición Invertida en Radiografía

El examen roentgenológico del enfermo en una posición de 50 grados de inversión le ha resultado al A. de mucho valor para visualizar partes del canal alimenticio, y en particular la porción inferior del esófago y la S ilíaca, y para concentrar el medio de contraste a fin de obtener imágenes de la pelvis renal durante la pielografía endovenosa.

El aparato consta de una bata suspensoria, que se pone el enfermo, hecha de lona, la cual se une a una placa desmontable de aluminio. Esta placa a su vez se asegura a una ménsula o brazal unido a un ángulo de 90 grados a la pata de una mesa de rayos X, de las de báscula. La placa revuelve sobre un eje introducido en la ménsula y en línea con el eje central largo de la mesa de rayos X a unos 12.5 cm. más arriba de la superficie de la mesa.

El empleo de este procedimiento no ha producido efectos nocivos en los enfermos ambulantes examinados en la práctica del A. Es de notar que no ha sido utilizado en asmáticos o en sujetos con descompensación cardíaca.

Chorionepithelioma of the Uterus

A Résumé of the Literature and Presentation of Two Cases[1]

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THE TRUE INCIDENCE of chorionepithelioma is difficult to determine. Reports from a variety of sources representing some thousands of autopsies establish only the fact of its rarity. Probably the most accurate figure is that of Schumann and Voegelin (13), namely 1 in approximately 13,850 pregnancies. No detailed accounts of chorionepithelioma treated by radiation have appeared in the American radiologic literature, though abstracts of some foreign papers have been published. In the two cases to be reported here, roentgen therapy led to regression of the primary tumor with spontaneous disappearance of pulmonary metastases.

ETIOLOGY

Except for rare cases originating in teratomata, all chorionepitheliomas follow pregnancy. So-called ectopic chorionepitheliomas represent instances in which the primary tumor has disappeared or in which dormant chorionic emboli from a preceding pregnancy have undergone malignant transformation. Sears (14) and Soresi (15) reported such types developing in the jejunum. About half of all cases seem to follow hydatidiform moles, the recorded percentages ranging from 33 to 80. The other half are equally divided between full-term pregnancies and abortions, except for 2 or 3 per cent following ectopic pregnancies.

The proportion of moles that become malignant is difficult to assay but it probably does not exceed 1 per cent. Novak (10) is of the opinion that the higher rates for malignant degeneration of moles are based on incompletely removed benign moles which are later misinterpreted as malignant.

CLINICAL ASPECTS

Age: Older women are more susceptible to malignant degeneration of moles. Szathmary's analysis, as quoted by Gough (6), indicates that under forty years of age, moles precede chorionepitheliomas in 37.7 per cent of cases, while in patients over forty years the percentage is 68. This is independent of the number of pregnancies.

Period of Latency: Chorionepithelioma may develop either during pregnancy or after a latent period of many years. This fact is well documented. Feiner (5) collected 47 cases with latent periods of one to thirty years and Lynch (7) has made reference to a thirty-one-year interval. The most convincing instance of a long latent period is furnished by Kroesing's case, reviewed in detail by Lynch and Maxwell (8). Long latent periods are, however, admittedly uncommon. The average interval is a matter of weeks.

Symptoms: Vaginal bleeding following any of the terminations of pregnancy mentioned above is the commonest symptom and is accompanied by weakness, cachexia, and anemia. On the other hand, the initial symptom may be a sudden, catastrophic intra-abdominal hemorrhage due to growth of tumor through the uterine wall (3), without bleeding from the vagina. Other symptoms are those referable to metastases. These, indeed, may be the only ones if the primary tumor has regressed spontaneously or has been expelled (9, 11).

Metastases: Metastases occur early through the blood vessels. A half or more of the cases metastasize to the lungs and vagina. The bluish, hematoma-like vaginal metastases are characteristic. Other frequent sites are the liver, brain, kidneys,

[1] From the Department of Radiology, Los Angeles County Hospital, Los Angeles, Calif. Accepted for publication in June 1950.

and spleen. Untreated or unsuccessfully treated cases usually terminate in six to nine months.

PATHOLOGICAL CONSIDERATIONS

Chorioadenomas occasionally metastasize to the parametria, vagina, and lungs. This is allegedly the tumor in which expulsion or resection of the primary growth or a vaginal metastasis may sometimes result in spontaneous regression of the secondary lesions. Our two cases demonstrate, however, that at least where the primary tumor is *irradiated*, such phenomena are not limited to chorioadenoma. Both tumors were diagnosed histologically as choriocarcinoma, and in both spontaneous regression of pulmonary metastases occurred.

With due regard for the not infrequent exceptions, two generalizations appear valid. First, the better the preservation of the morphology of the villus as a unit, the less malignant is the tumor. Choriomas with malignant tendencies following moles are apt to be of this type. Second, the greater the preponderance of Langhans' cells over syncytial cells, the more malignant is the tumor. Syncytiomas, conversely, are relatively benign.

DIAGNOSIS

Because of the dangers attendant upon curettage and the difficulty of making a diagnosis of choriocarcinoma from material thus obtained, a wide variety of diagnostic procedures have been advocated. These include dependence on the "pathognomonic" symptom of recurrent hemorrhage after a curettage performed subsequent to a pregnancy or mole, vaginal hysterotomy and digital palpation of the uterine canal, routine laparotomy, and total reliance on pregnancy tests.

Pregnancy Tests: Hormonal diagnosis based on quantitative tests is perhaps the best diagnostic aid, provided the tests are not misinterpreted through dependence on arbitrary standards of various hundreds of thousands of units. Only *increasing* titers of chorionic gonadotropic hormone in serial quantitative tests of the urine or blood will justify, as a rule, the diagnosis of chorioma with malignant tendencies and the consequent radical therapeutic measures required. In the rare case of chorioma in which hormonal tests are persistently negative from the outset, there is little alternative but curettage in the presence of a suggestive history.

TREATMENT

Panhysterectomy and bilateral salpingo-oophorectomy is the most commonly advocated form of treatment. A review of the literature reveals cure rates ranging from 40 to 100 per cent. Such claims are patently absurd and in no instance have the authors making them subjected their cases to analyses indicating that consideration was given to the real problems of correctly diagnosing a true chorionepithelioma or choriocarcinoma. Most of such cases are in reality chorioadenomas or syncytiomas. Ewing (4), Lynch and Maxwell, and Rosenzweig (12) have collected incorrectly diagnosed cases from the literature.

Most writers express parenthetically a familiarity with the theoretical advantages of treating an embryonic tumor by radiation, but there seems to be a singular reluctance to employ this agent for any but surgical discards. Even in cases receiving radiation the technic of treatment usually is not outlined adequately. In the American literature, of all the cases treated by radiation, the one most satisfactorily presented is that of Davis and Brunschwig (2). Since the development of the Aschheim-Zondek test, it has been possible to assess the results of treatment by periodic pregnancy tests, an advantage the older investigators did not have.

PROGNOSIS

The great majority of choriocarcinomas terminate fatally. The exact figures are uncertain. Novak's figure of 70 to 80 per cent fatality must be considered low in the light of his definition of chorionepithelioma. Unsuccessfully treated cases usually recur within a year.

Stander's (16) contention that the pres-

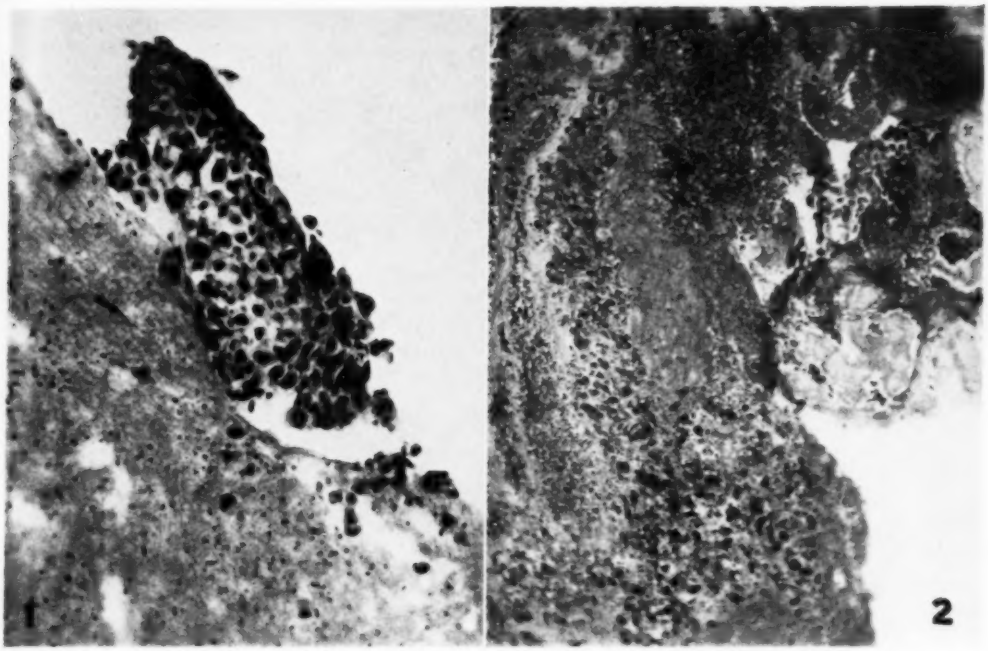

Fig. 1. Case I: Tissue extruded from uterus (medium power). An anaplastic mass of tumor cells with mitotic figures is seen.

Fig. 2. Case I: Biopsy of bladder (low power). Malignant tumor cells are infiltrating the necrotic bladder mucosa. There is also a clump of tumor cells at the upper right.

ence of metastases gives a hopeless prognosis is refuted by others, as well as by our own cases. Lynch and Maxwell stated more cautiously that pulmonary and vaginal metastases did not imply a fatal termination but that death ensued rapidly in the great majority if the former were accompanied by cough and hemoptysis. Our second case is a remarkable exception to this rule. Both of our cases refute the assertion of Acosta-Sison and Espaniola (1) that moderately advanced cases do not yield to roentgen therapy.

CASE HISTORIES

CASE I: M. S., a 21-year-old married white female, entered the Los Angeles County Hospital Jan. 1, 1942, because of vaginal bleeding at irregular intervals since September 1941, when, because of vaginal hemorrhage for one week, the uterus, then three months pregnant, was emptied by curettage. She had had normal pregnancies in 1937 and 1938 and an induced abortion in 1940.

Because of the continued bleeding, transfusions were required during the first three days. Hematuria was also noted, and during cystoscopy, on Jan. 4, one and one-half pints of blood clots were evacuated from the bladder. A biopsy was taken from a 1 cm. irregular sessile tumor on the floor of the bladder. This was first thought to be a highly anaplastic transitional-cell carcinoma but, after comparison with tissue subsequently extruded from the uterus, it was diagnosed as "highly malignant choriocarcinoma" (Newton Evans, M.D.) (Figs. 1 and 2). A roentgenogram of the chest on Jan. 13 was negative for metastases. On Jan. 19 a blood Friedman test was strongly positive.

Roentgen therapy was begun on Jan. 19, the factors being 200 kv., 20 ma., filtration 0.5 mm. Cu plus 2 mm. Al, target-skin distance 50 cm., h.v.l. 1.1 mm. Cu. Treatment was given through a 15 × 15-cm. suprapubic port, at 32.8 r per minute. The initial dose was 100 r with subsequent increments of no more than 150 r daily. The total was approximately 1,600 r in air, given over a twelve-day period. Due to the patient's extremely poor condition, there was a delay of twenty-four days before additional treatment could be given. For this, two 10 × 10-cm. gluteal ports converging at the bladder were used, and the dosage was 200 r a day to one area. The ports were alternated. The totals were 1,800 r (in air) to each port, given over a twenty-eight-day period. The total tumor dose to the mid-pelvis was approximately 3,100 r.

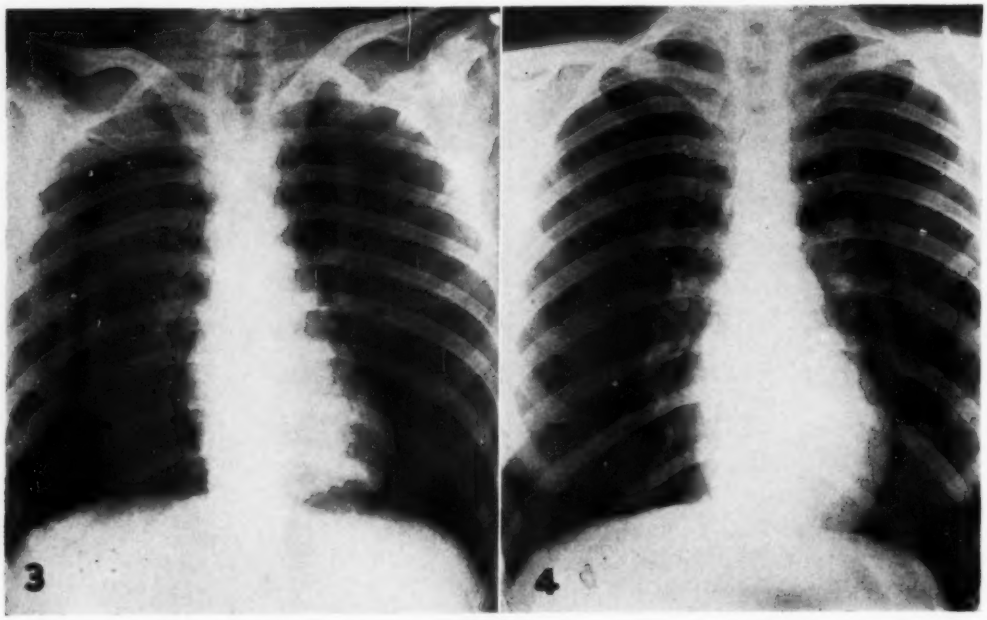

Fig. 3. Case I: Supine chest film (Feb. 19, 1942), showing discrete tumor nodules occupying the periphery of the upper half of each lung.

Fig. 4. Case I: Chest film (June 30, 1942), showing disappearance of metastases seen in Fig. 3.

On Feb. 17, in the interval between the two courses of therapy, the patient became dyspneic, and a roentgenogram of the chest two days later showed faint but sharply circumscribed nodules 0.5 to 1 cm. in diameter in the periphery of the upper half of either lung field (Fig. 3). The second course of treatment, however, was accompanied by steady improvement, and on March 29 the patient was ambulatory. A roentgenogram of the chest was entirely negative for metastases on June 30 (Fig. 4). The blood Friedman test was negative on Sept. 15, 1942, and has remained so ever since.

CASE II: B. Q., an 18-year-old unmarried Negro female, a dancer and typist by occupation, entered the hospital May 16, 1942, in her first pregnancy and passed a typical benign hydatidiform mole during the third month of gestation. She failed to appear again until Feb. 8, 1943, when she was admitted in the clinical picture of shock. There was an interval history of irregular menses since June 1942. The last menstrual period, in December 1942, was a normal one and was followed by amenorrhea until a profuse vaginal hemorrhage occurred during the four days preceding hospital entry. On Feb. 10, a severe hemorrhage with another episode of shock occurred following careful exploration of the uterus with a dull curette. The microscopic report on the tissue obtained was choriocarcinoma. On Feb. 11, a panhysterectomy and bilateral salpingo-oophorectomy was performed. The tumor was not completely removed, the incision in the right broad ligament cutting through tumor tissue. The pathologic report by Dr. Hugh Edmondson[2] was choriocarcinoma (Fig. 5). Radiation therapy, with the factors described in the previous case, was begun five days postoperatively. The treatment was given through four 10 × 10-cm. pelvic ports—two anterior and two posterior. The areas were treated in rotation, only one on any given day. Over a period of forty-three days, 16 treatments of 200 r and 12 of 300 r were administered, for a total of 1,700 r (in air) to each port. The total tumor dose to the mid-point of each erstwhile parametrium was approximately 1,650 r.

While treatment was in progress, a Friedman test of the blood serum was positive on March 4, and a quantitative test was positive in a 1:100 dilution on March 15. A roentgenogram of the chest on March 17 showed no metastases. At the completion of treatment, a nodular induration in the right side of the pelvis was found, and the Friedman test was again positive.

The patient was discharged from the hospital on March 31 to be followed in the outpatient clinic. A week later she had hemoptysis, chest pain, and anorexia. A chest roentgenogram on April 9 showed nodular lesions with hazy borders in both lungs,

[2] We are indebted to Dr. Hugh Edmondson for reviewing the pathological material in these cases.

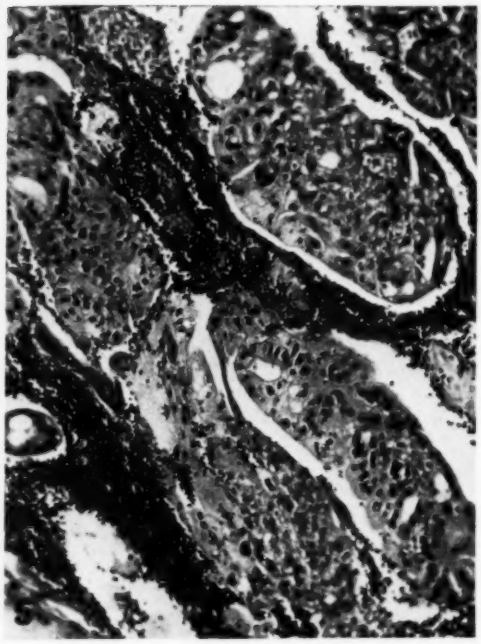

Fig. 5. Case II: Section from uterus (medium power). Masses of tumor cells are invading the uterine wall.

such as occur in metastatic chorionepithelioma in which there has been hemorrhage into the surrounding parenchyma (Fig. 6). Pelvic examination disclosed a firm, tender nodular mass at the apex of the vagina, with a large, fixed, tender mass above it.

One month later, May 15, pelvic examination was entirely negative. On May 20, the patient again reported the occurrence of hemoptysis, but the chest pain had ceased, appetite was good, and there had been a gain of 4 pounds in weight. A roentgenogram of the chest on June 25 showed disappearance of all nodules save one in the left mid-lung field. On June 30 there were no chest symptoms. By July 14 the patient had gained an additional 8 pounds, and pelvic examination was negative. The blood Friedman test was positive on Aug. 7, and hemoptysis was reported on Aug. 31, although a chest film was negative at the time (Fig. 7). One week later the patient won first prize in a "jitterbug" contest and a month later was named as winner in a national beauty contest.

Roentgenograms of the chest on Jan. 15, 1944, April 20, 1944, and Oct. 23, 1945, were negative. Friedman tests remained positive on Dec. 13, 1943, March 9, 1944, and Sept. 8, 1944. The patient then had an episode of acute gonorrhea with no apparent ill effects or change in the Friedman tests, which were again positive on May 15, 1945, Oct. 24, 1945, and Jan. 22, 1947. During all this time she was dancing strenuously in three theatrical

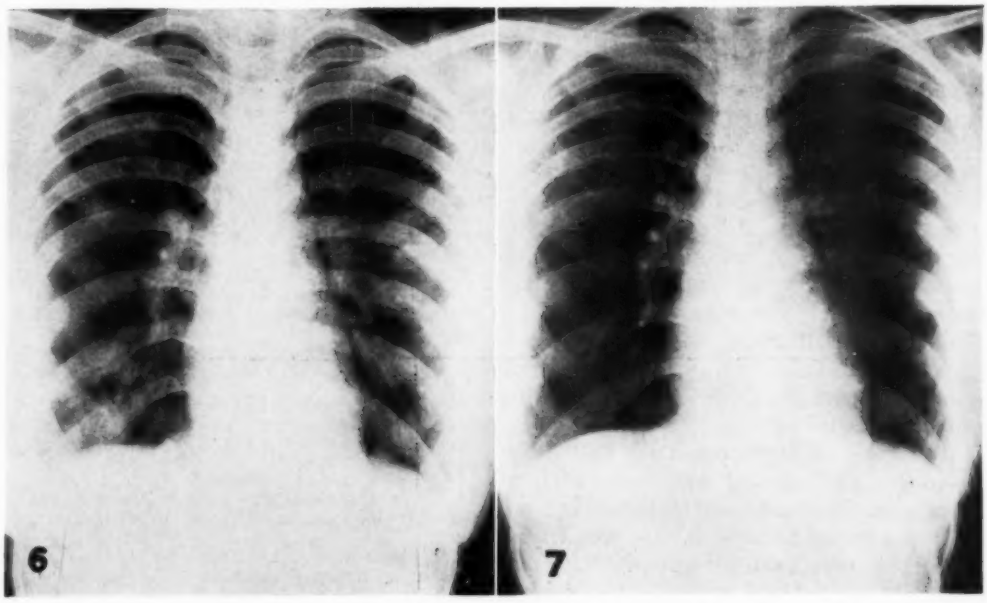

Fig. 6. Case II: Chest film (April 9, 1943), showing metastatic nodules in the right subapex and base and in the left mid-lung.

Fig 7. Case II: Chest film (August 1943), showing disappearance of the metastatic nodules seen in Fig. 6.

shows nightly. The Friedman test was finally negative on Dec. 18, 1947, and again on Dec. 19, 1949. A chest film was negative on the latter date.

COMMENTS

Case I followed an abortion, as is true of about 25 per cent of chorionepitheliomas. It is uncertain whether Case II developed from a mole or during the first trimester of a second pregnancy. The evidence favors the latter.

The presenting symptoms in both patients were characteristic of chorionepithelioma, though in no way pathognomonic. Metastases occurred in the two commonest sites, the vagina and lungs.

In Case II, following incomplete resection of the tumor, the disease continued to progress until the pulmonary metastases became clinically evident. Regression was not apparent until two weeks after the completion of roentgen therapy. In view of this sequence of events, it would be leaning too far backward in the interest of scientific objectivity to assert that the curative role of radiation was not definitely established in this case because some surgery had been done previously.

The first post-irradiation Friedman test in Case I was performed six months after treatment and was negative. Earlier tests were not done to determine just when the change occurred, no doubt because a cure was not expected.

Case II presents the amazing phenomenon of a positive Friedman test persisting in an ostensibly cured patient for four years following treatment. It finally became negative after more than four and a half years. Although the situation is not exactly parallel, this observation lends more credence to those cases developing after long latent periods.

We have no explanation for the disappearance of pulmonary metastases without treatment directed toward them, but we have occasionally seen this occur in lymphomas in which the presence of the tumor has actually been proved by biopsy in the node that has disappeared spontaneously.

SUMMARY

Two cases of choriocarcinoma of the uterus treated by roentgen rays are presented. One patient was still well after seven years and the other after seven and a half years. Both showed spontaneous regression of pulmonary metastases following irradiation of the pelvis. One case may be unique in that the tumor was first discovered in the bladder.

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SUMARIO

Corioepitelioma del Utero: Repaso de la Literatura y Presentación de Dos Casos

Los dos casos presentados son de coriocarcinoma uterino tratado con los rayos X. Una enferma se hallaba todavía bien al cabo de siete años y la otra al cabo de once años y medio. Ambas revelaron regresión espontánea de las metástasis pulmonares a continuación de la irradiación de la pelvis. Un caso tal vez sea único por haberse descubierto el tumor primero en la vejiga urinaria.

Pharmaco-Cholangiography in the Diagnosis of Odditis[1]

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SUCCESSFUL SURGERY of the biliary tract depends in large part upon the correct diagnosis and adequate treatment of benign lesions of the duodenal segment of the choledochus or common bile duct. The sequelae of these lesions are due in the majority of cases to failure to detect them in the first place and to the residual cholelithiasis which is overlooked by the surgeon because of the difficulties entailed in exploration of this part of the biliary system.

Benign lesions represented by morphologic changes in the biliary tract may be listed as follows: (*a*) lesions of the sphincter of Oddi; (*b*) "Odditis"; (*c*) biliary dyskinesia; (*d*) diseases of the transpancreatic portion of the common duct; (*e*) chronic pancreatitis; (*f*) cholelithiasis.

The sequelae may be classified as (*a*) those incident to striking symptoms and (*b*) those following mild symptoms. According to our statistics, 90 per cent are associated with lesions of the duodenal segment of the common duct which have escaped diagnosis and treatment. Discovery of such lesions has been facilitated in recent years by operative cholangiography, which not only establishes the diagnosis with great facility but also indicates the surgical measures to be taken.

In only one instance does this procedure, as usually practised, fail to reveal the exact type of lesion and thus serve as a guide to the surgical treatment, namely, inflammation of the sphincter of Oddi, or "Odditis." Here the surgeon may find himself at a loss to interpret the findings as shown on the films and to make the distinction between organic disease and a functional disturbance.

Odditis may be defined as a chronic inflammatory process involving the terminal portion of the common bile duct and the sphincter of Oddi, tending to narrow the lumen and producing symptoms characteristic of cholelithiasis and biliary colic. These are among the acute sequelae of cholecystectomy. The clinical diagnosis of Odditis in its most advanced or sclerotic form is impossible. The intermediate or spastic forms offer equal diagnostic difficulty, for while the condition may be suspected to be of biliary or sphincteric origin, an exact diagnosis cannot be made, in spite of opinions to the contrary expressed by such writers as del Valle. Clinically there is severe colic with radiation of pain to the left; bile obtained on duodenal intubation contains mucus and numerous cholesterin crystals; choluria occurs during the crisis, and jaundice is present. All these symptoms, if present, must be taken into consideration, but it is still impossible to determine to what extent they are due to cholelithiasis and to what extent to involvement of the sphincter.

Recourse must therefore be had to surgical intervention and operative cholangiography, to determine the exact cause of the obstruction of the duodenal segment of the common duct. This obstruction, which may vary in degree up to complete closure of the papilla of Vater, should be measured. Systematic exploration of the common duct, with catheterization of the sphincter, has been recommended for this purpose. However, not only are the results of such a procedure unsatisfactory, but attempts to pass the sphincter involve a considerable risk. Manometry, on the other hand, aside from being a complicated procedure, cannot, in the face of

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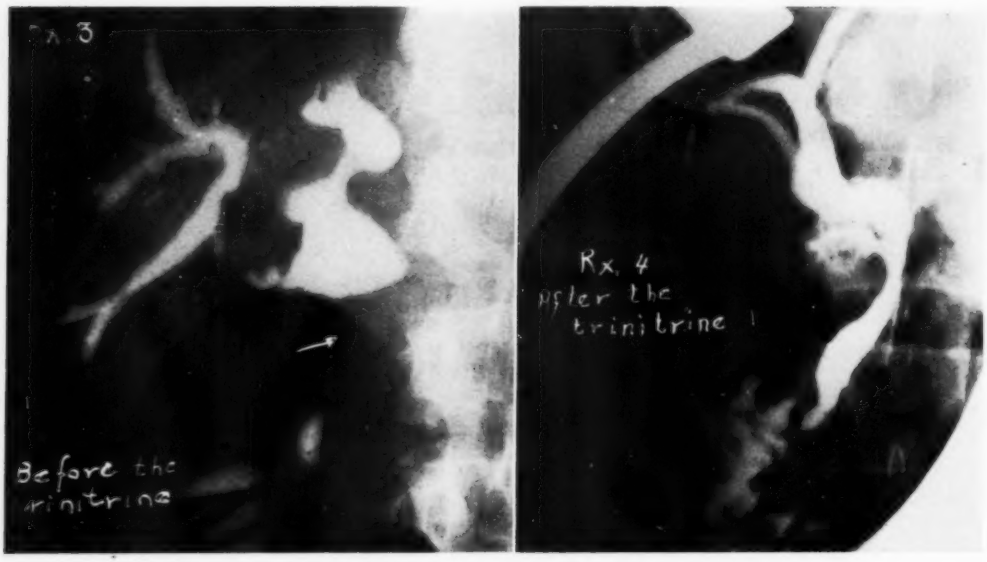
Figs. 1 and 2. Cholangiograms obtained before and after administration of trinitrin.

increased tension, establish whether this is a consequence of transitory or permanent obstruction. It is for these reasons that we consider pharmaco-cholangiography with the use of an anesthetic and antispasmodic the ideal method for determining the degree of damage to the sphincter. This simple procedure can be carried out at the time of operation, thus serving as a guide to the surgeon and preventing the occurrence of serious postoperative sequelae.

Pharmaco-cholangiography is based on the well known double innervation of the sphincter of Oddi, the superior part of which is under vagal control while the inferior part—the papilla—is governed by the sympathetic fibers. This double innervation has led some investigators, notably Archibald and Westphal, and later Ivy and Meltzer, to interpret the nervous influence of the vegetative fibers upon the biliary tract and upon the sphincter of Oddi as the classical example of antagonistic vagal-sympathetic innervation. Thus (*a*) stimulation of the sympathetic fibers produces hypotension and paralysis of the gallbladder and choledochus, and at the same time contraction of the sphincter of Oddi, while (*b*) stimulation of the pneumogastric fibers produces hypertension and hyperkinesia of the gallbladder and duct and relaxation of the sphincter of Oddi.

Though various authors have offered different interpretations of the vago-sympathetic action upon the common bile duct, it is established beyond question by our experience in the clinic of Professor Urrutia that splanchnic anesthesia and trinitrin (glyceryl trinitrate or nitroglycerin) produce a relaxation of the sphincter. In order, therefore, to suppress the functional mechanism, we produce a splanchnic block with novocaine and alcohol prior to operation, following the practice of Dr. Miguel Lopez Esnaurrizar, of Mexico, who has employed the procedure in some cases of abdominal pain. Puncture is done according to the technic of Albanese and 20 c.c. of 1 per cent novocaine is injected, followed in two minutes by 10 c.c. of 96 per cent alcohol. (These doses are subject to some variation depending on the weight and bodily habitus of the patient.) The block is accomplished from the right hand side, the anesthetist at the same time checking the fall in arterial pressure and slowing of the heart.

As soon as cholecystectomy is com-



Figs. 3 and 4. Cholangiograms obtained before and after administration of trinitrin.

pleted, and after the first operative cholangiogram has been obtained, 3 drops of a solution of trinitrin (1 per cent) are placed beneath the patient's tongue by the anesthetist. This is followed by a fall in the arterial pressure, which, however, promptly returns to normal. In this way we make sure that if, in spite of the splanchnic block, emptying of the biliary tract has not occurred at the time of exposure of the first film, relaxation of the sphincter of Oddi will be obtained by the action of the trinitrin. Thus no time is lost and we guard against failure of splanchnic block. By the use of novocaine and alcohol we seek to protect the sphincter mechanism by suppressing sympathetic stimulation. If spasm of the sphincter persists, the trinitrin acts upon the vagus fibers. In other words, by this double pharmacologic action, all nervous stimulation of the sphincter of Oddi is suppressed.

If the first cholangiogram—before the administration of trinitrin—shows a completely evacuated biliary tract, the operation continues. If not, a second film is obtained after trinitrin has been given, and sometimes a third within five minutes of the second. If the papilla remains closed, the diagnosis of an irreversible organic lesion of the sphincter of Oddi is established.

For the operation itself general anesthesia with gas and ether is used. This acts as a safeguard against a fall in blood pressure as a result of the action of the novocaine and trinitrin. Among more than 100 cases in which the technic described has been employed there has been but one death, and that in a patient operated upon under spinal anesthesia.

We have grouped our cases as follows:

Group 1 (20 per cent of the total): Cases in which the first cholangiogram, before trinitrin administration, has shown complete evacuation of the choledochus.

Group 2 (40 per cent): Cases in which both splanchnic anesthesia and trinitrin were used and the second film showed complete evacuation of the choledochus.

Group 3 (25 to 28 per cent): Cases in which both splanchnic anesthesia and trinitrin were used and the third film showed evacuation of the choledochus but with some residual contrast medium.

Group 4 (4 per cent): Cases in which both splanchnic anesthesia and trinitrin were used but a fourth film showed incomplete evacuation of the common duct.

Group 5 (4 per cent): Cases in which both splanchnic anesthesia and trinitrin were used but in which the first three films showed that little or none of the contrast medium had entered the duodenum.

To these may be added a sixth group in which false images of stones fixed in the papilla were obtained but disappeared after administration of trinitrin.

From this classification it is seen that in more than 90 per cent of the cases the sphincter proved to be normal and the lesion reversible, while in 6 to 8 per cent a permanent or irreversible lesion was present.

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SUMARIO

La Farmaco-Colangiografía en el Diagnóstico de la Odditis

En presencia de inflamación del esfínter de Oddi—la llamada odditis—los hallazgos aportados por la colangiografía operatoria acaso no pongan en claro la distinción entre afección orgánica y trastorno funcional.

Los AA. han observado que la anestesia esplácnica y la trinitrina producen relajación del esfínter. Antes de la operación, provocan un bloqueo esplácnico con novocaína. Si la primera radiografía postoperatoria no muestra completa evacuación del aparato biliar, colocan tres gotas de una solución al 1 por ciento de trinitrina debajo de la lengua del enfermo y toman una segunda (y a veces una tercera) colangiografía. Si el colédoco todavía no se vacía, queda establecido el diagnóstico de lesión orgánica del esfínter de Oddi.

En una serie de casos examinados por los AA., sólo unos 6 a 8 por ciento mostraron lesión permanente o irreversible.

Penumbra Effect in Therapy Cones[1]

ANTOLIN RAVENTOS, M.D.[2], and GERHART S. SCHWARZ, M.D.[3]

MOST DEEP X-RAY therapy cones currently in use or commercially available are so-called "false" cones, *i.e.*, they contain a collimating lead diaphragm at or near the tube-end which is designed to restrict the x-ray beam to the size of the desired treatment portal. The side walls consist of light, thin, moderately radiotranslucent sheet metal, the sole function of which is structural support. Sometimes these side walls contain observation windows. In occasional instances they may serve to absorb scattered radiation from the patient.

The field delimited by such a collimating lead diaphragm is not of uniform intensity, due to the fact that the focal spot from which the rays originate is not a single point, but an area of considerable magnitude. As a result, the skin portal consists of a central zone of full intensity surrounded by a penumbra zone of partial intensity. The penumbra effect, although well known, has apparently not been taken into full consideration by all manufacturers.

The size of the central zone of full intensity in the skin portal produced by this type of cone-diaphragm is given by Formula 1:

$$P = D + (D - FS)\frac{d''}{d'}$$

where

P = skin portal zone of full intensity (one dimension)
D = diaphragm aperture (one dimension)
FS = focal spot (corresponding dimension, as seen from the treatment portal)
d'' = distance from diaphragm to skin portal
d' = distance from focal spot to diaphragm

The width of the penumbra zone on each side of the portal is given by Formula 2:

$$PU = FS \times \frac{d''}{d'}$$

where

PU = width of penumbra, and the other symbols are the same as in Formula 1

Within this zone, the intensity of the primary beam falls from 100 per cent at the inner margin to zero at the outer margin. As the beam passes deeper into the tissues, the penumbra zone becomes wider, creating an area of uncertainty in attempted isodose calculations (1, 4). The width of the penumbra zone at any depth can be calculated by Formula 2 if the distance from the skin to the depth in question is added to the value of d''.

The experience of the authors is cited with such a cone, made by a well known manufacturer for use with a popular 200-kv.p. x-ray therapy generator, and represented as furnishing a 10 × 10-cm. skin portal and an 80-cm. focus-skin distance. It contained a square lead diaphragm at its tube-end, its aperture measuring 3.7 × 3.7 cm. and located about 29 cm. from the target. The actual field produced by this cone is shown in Figure 1A, where a photographic film was placed in the position of the patient, and in Figure 2A, where isodose curves for the area covered by the cone are given. (All measurements were made with a Victoreen condenser r-meter.)

The useful projection of the focal spot in this equipment was measured by a modification of the pinhole camera method of Hodges (2). It was found to be a rough trapezoid (Fig. 3) measuring 2.48 × 0.61 cm. This tube was of recent purchase, a General Electric type XPT tube, which we understand enjoys fairly wide use. The skin portal calculated by Formula 1 for this focal spot and cone measured 5.8 × 9.1

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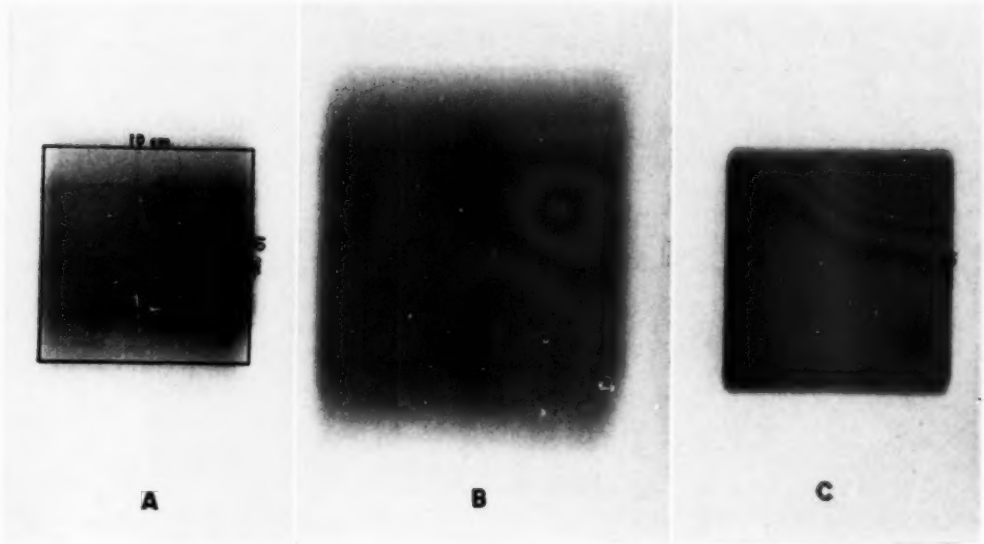

Fig. 1. A. Uneven blackening of film, showing non-uniform treatment field obtained with manufacturer's cone, due to penumbra effect.
B. Film showing effect of enlarging the diaphragm aperture. Uniformity over the entire treatment portal is obtained, but the field is much larger than 10 × 10 cm.
C. Film showing field distribution if diaphragm aperture is enlarged and the umbrella diaphragm added. A uniform 10 × 10-cm. field is obtained.
Factors: 200 kv.p., 5 ma., 80 cm. F.S.D., 2 seconds exposure. Eastman Kodak Blue Brand film. No intensifying screens.

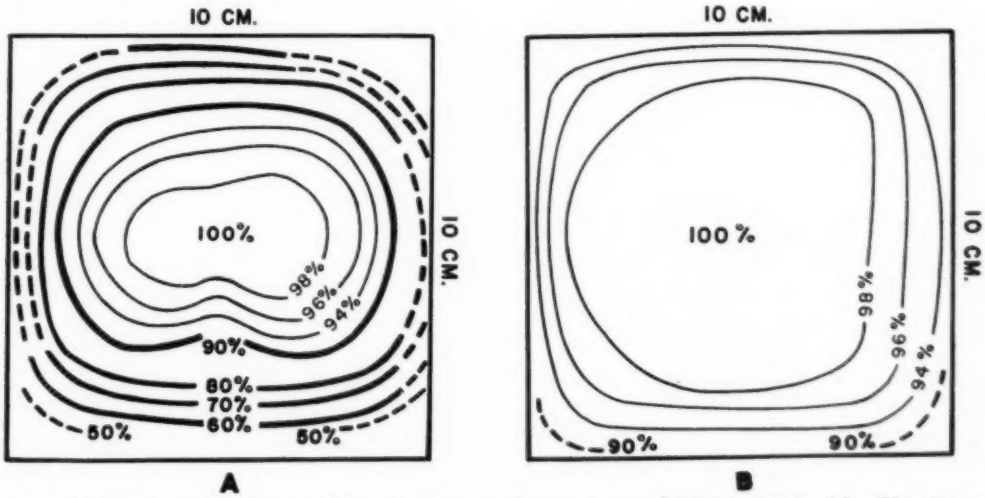

Fig. 2 Isodose curves for treatment field. A. For manufacturer's cone (measurements in air). The corners of the field receive only 50 per cent of the central intensity. B. With use of "umbrella" cone.

cm. and had a penumbra zone 4.4 cm. in width on the long side and 1.1 cm. on the short.

It can readily be seen that the use of this cone in treatment, under the assumption that it provided a homogeneous 10 × 10-

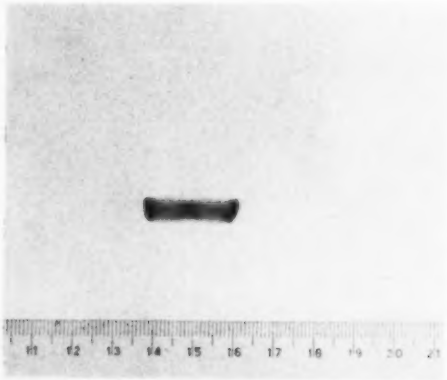

Fig. 3. Pinhole roentgenogram of therapy tube focal spot. Actual size of focal spot identical with its radiographic image shown by metric ruler.

cm. field of intensity equal to the central portion, would result in a substantial underdosage in the periphery of the field, where the intensity may actually fall as low as 50 per cent. This is far in excess of the ever-present marginal intensity drop caused by lack of contributing scattered radiation within tissue, particularly when narrow beams are used. In conditions such as carcinoma of the larynx, a slight misdirection of the beam might cause tumor tissue to lie within the low-intensity portion of the field and result in failure to deliver a cancerocidal dose.

Known or obvious ways of restoring uniform intensity to the treatment field include the following:

(1) Use of a larger diaphragm, projecting the penumbra zone outside of the treatment portal. This was found to give intensities at 200 kv.p. up to 10 per cent of the central beam outside of the area covered by the radiotranslucent side walls of the cone, and was deemed unsatisfactory in the event that the area receiving penumbra radiation might overlap another treatment portal or extend over organs that are thought to be safely protected (eyes, hair, jaw, etc.).

(2) Careful masking of the treatment portal with lead rubber or other radiopaque material. This is standard technic with many careful therapists even when accurately collimated cones are used. It is not a practical substitute for accurate collimation because of the difficulty of masking tightly on irregular body surfaces.

(3) Use of a true cone, *i.e.*, a lead-walled one, undesirable because of its weight.

Fig. 4. Authors' cone with enlarged diaphragm and "umbrella." The brim of the "umbrella" extends through the radiotranslucent walls of the cone.

(4) Use of a longer lead-walled master cone and shorter interchangeable treatment cones, since the closer the diaphragm lies to the patient's body the narrower the penumbra zone becomes. This is impractical because it would involve either a change in the manufacturer's design or extensive rebuilding of equipment by the individual user. Also, it defeats its own purpose because it makes the master cone excessively heavy. The use of short target-skin distances would be prevented altogether.

(5) Reducing the size of the focal spot. Therapy tubes with smaller focal spots are available, but can be used only with certain types of x-ray generators, chiefly of

recent manufacture and with oil-immersed heads.

(6) A compensating filter, thicker in the center than at the periphery, which would give uniformity of intensity to the field but would greatly reduce the r/min. output. The quality of the beam would, of course, then vary through the field (3).

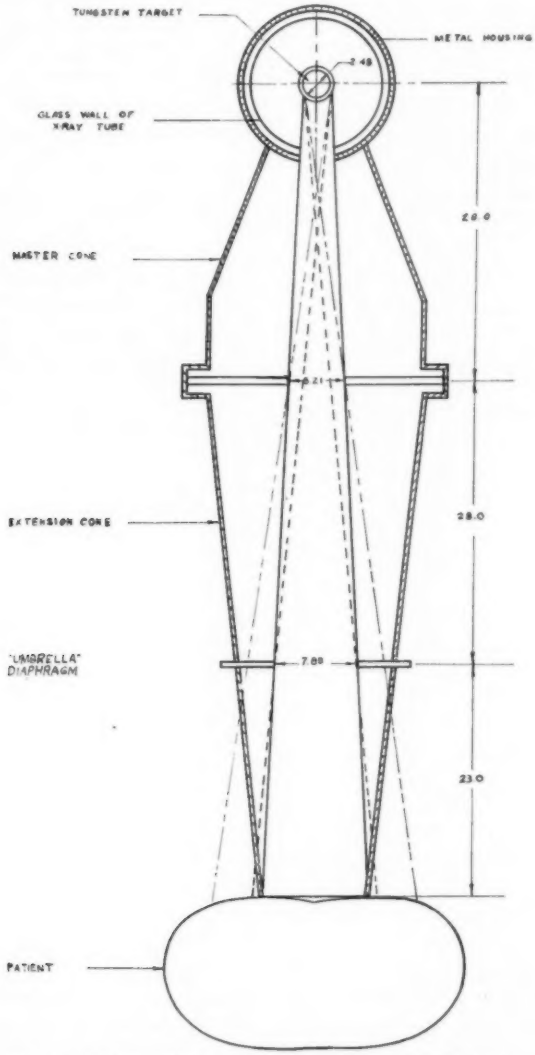

Fig. 5. Diagrammatic section through "umbrella" cone.

The most practical solution to the problem was found to be the use of a diaphragm at its usual location but with an aperture larger than its purely geometrical requirements for a point source, placing the penumbra entirely outside of the treatment portal. To absorb the penumbra radiation which escapes through the radiotranslucent side walls of the cone, a lead "umbrella" was attached to the cone near its distal end. The "umbrella" consists

of a lead diaphragm the aperture of which was 7.8 cm. square in this particular case. Its flanges protrude beyond the confines of the cone and absorb the penumbra radiation of the enlarged diaphragm aperture at the tube-end of the cone (Fig. 4). The "umbrella" aperture produces a small penumbra of its own, but the "umbrella" can be placed at such a distance above the skin that its own penumbra does not exceed a width of 1 cm. or any other value which is considered permissible. In the instance cited, an "umbrella"-skin distance of 23 cm. was selected; the "umbrella" thus did not interfere with the accurate placing of the cone on the skin area designated for treatment. Its penumbra zone was 1 cm. in width on the skin.

SUMMARY

1. In certain instances, the collimating lead diaphragm now in common use in x-ray therapy equipment results in a marked inequality of intensity throughout the treatment portal.

2. Radiologists are urged to investigate the entire field and the adjacent areas outside of each cone that they use, either with films[2] or by actual ionization measurements, because of the mechanism described, and other mechanisms as well, which may make the field of a given cone used with one x-ray generator quite different from the field of the same cone used with another apparatus.

3. The authors propose the use of an "umbrella" cone to obtain more uniform intensity in a well confined treatment field.

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[2] Over-exposure has to be avoided because it will blacken the film uniformly regardless of field distribution.

SUMARIO

El Efecto de Penumbra en los Conos de Terapéutica

En ciertos casos, el diafragma de plomo colimador, tan empleado en las instalaciones roentgenoterapéuticas, da por resultado una pronunciada desigualdad en la intensidad por toda la puerta de tratamiento.

Convendría que los radiólogos investigasen todo el campo y las zonas adyacentes fuera del campo de cada cono que empleen, ya con radiografías o con mediciones de la yonización, debido al mecanismo descrito, e igualmente a otros mecanismos, que pueden convertir el campo de un cono dado usado con un generador de rayos X en un campo muy distinto del mismo cono usado con otro aparato.

El empleo de un cono con "parasol" permite obtener intensidad más uniforme en un campo terapéutico bien limitado. Esto entraña el empleo de un diafragma en el sitio habitual, pero dotado de una abertura mayor que lo necesario desde un punto de vista puramente geométrico para un foco localizado, de manera que la penumbra queda absolutamente fuera de la puerta de tratamiento. El "parasol," unido al cono en su extremo distal, consiste en un diafragma de plomo, cuya abertura en el caso actual, medía 7.8 cm.[2]. Las pestañas proyectan más allá de los límites del cono y absorben la irradiación de la penumbra derivada de la agrandada abertura del diafragma en el extremo del cono próximo al tubo.

Studies of Radium in Human Bone[1]

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EXTENSIVE EXPERIENCE with human beings and numerous animal experiments have shown beyond doubt that a portion of any quantity of radium which enters the body will be deposited in the bones, and that osteogenic sarcomas are often associated with small quantities of radium which have been fixed in the bone for considerable periods of time (1). The literature contains numerous references to osteogenic sarcoma associated with the presence of radium in the body (2).

Although the biochemical history of radium in the body is unknown, it is usually considered to be similar to that of calcium, and the method of deposition in the bones has been presumed to be the same (3). In another phase of these studies, we have found experimental evidence that the metabolic behavior of radium is not in all respects similar to that of calcium. The results of these studies are to be published later. The present report seeks only to illustrate and describe certain characteristic microscopic patterns of radium distribution in the matrix of human bones, to correlate these with the microscopic structure of the bone, and to evaluate approximately the tissue dosages associated with a few typical radium concentration patterns.

Through the courtesy of Dr. Harrison Martland, samples of bone obtained at autopsy from human victims of osteogenic sarcoma associated with some of the early reported cases of radium poisoning in the watch dial industry were made available for study. The investigations were based on the autoradiographic method and the bone sectioning method described in an earlier paper (4).

[1] Accepted for publication in May 1950.

The case histories have been given in detail by Martland (5). They are briefly summarized here:

E. E. (Case No. 2), female, died in December 1927 at the age of 32, seven years after leaving the dial-painting industry. She had been employed for three years in handling luminous paint containing radium. Autopsy showed extensive sarcoma of the right scapula which was diagnosed as osteochondrosarcoma. A profound anemia was present, and red, apparently regenerating bone marrow had entirely replaced the yellow marrow of the femurs. An estimate of 50 micrograms of radium distributed in the skeleton was based on chemical extraction of radium from samples of bone.

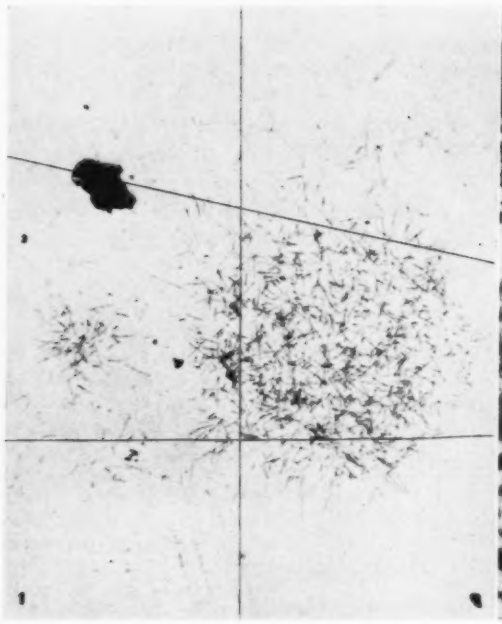
I. L. (Case No. 5), female, died in June 1931 at the age of 30, ten years after leaving the dial-painting industry. She had been employed for four years in handling luminous paint containing radium. Autopsy showed an osteogenic sarcoma springing from the periosteum of the ascending and descending rami of the left os pubis. An estimation of 8 micrograms of radium in the entire skeleton was made.

It will be noted that the bones which have been examined in these investigations have been preserved for periods of twenty-three years and nineteen years respectively since death.

AUTORADIOGRAPHIC RESULTS

Examination of alpha-particle autoradiograms has shown that the radium deposited in human bones is distributed in a manner somewhat similar to that in experimental rats. There appears, however, to be a significant difference.

Studies in Rats: In the bones of rats sacrificed soon after injection, the highest concentration of radium is in the periosteum and endosteum. In rats sacrificed several months after injection, the radium has been found heavily concentrated in a narrow ring within the bone, concentric with the marrow cavity. It is believed that this ring corresponds to bone which was in the process of deposition



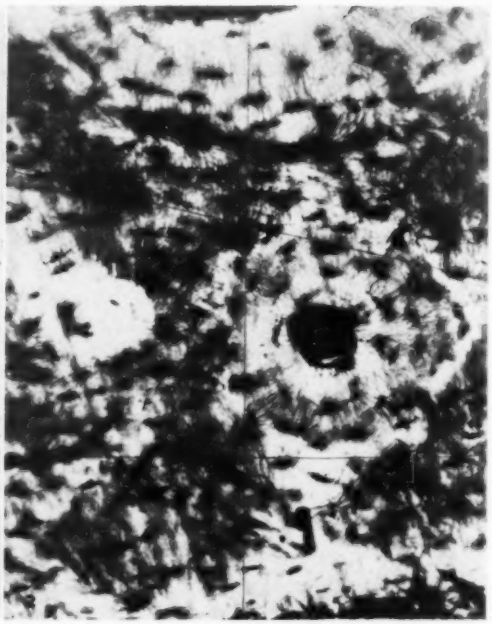


Fig. 1. Photomicrogram of alpha-particle track autoradiogram of section of human bone (E. E.). Exposure 423 hours. The distance between points of intersection of horizontal lines with vertical line is 257 microns.
Fig. 2. Photomicrogram of portion of human bone section corresponding to autoradiogram in Fig. 1. One of three serial sections from shaft of long bone. See also Figs. 4 and 6.

at the time of injection of the radium. (It may be recalled in this connection that the rat continues to increase in size practically throughout life.) Whether the animals were sacrificed early or after an interval of months, there were found also, within the bone matrix, microscopic localized concentrations of radium giving rise to alpha-particle track patterns in which a great preponderance of the tracks were radial with respect to a very small volume of the tissue. This volume may be as small as 25 microns in diameter (see Figure 5 in reference 4). Photomicrographic examination of the bone sections does not disclose any clear association of these patterns with any particular element of the bone matrix. There is thus nothing to indicate the manner of deposition of the radium in relation to haversian canals, lacunae, or other elements of the matrix. There do, however, appear to be differences in optical density of the bone associated with the radium deposits; the radium appears always to be associated with the optically denser areas.

Human Bone Studies: Several hundred sections have been cut from the specimens of bone from Martland's cases described above. In one case (I. L.) samples from several types of bone (vertebra, femur, pubic bone, and scapula) were examined. In the other case (E. E.), only portions of the shaft of the femur were available. This has unfortunately prevented comparison of radium deposition in all of the various types of bone in the two cases.

Comparison of the radium deposits in the shaft portion of a long bone (femur) has been accomplished in the two cases with interesting results. The autoradiograms of these shaft sections reveal localized concentrations of radium which differ from those found in rat bones. The alpha-particle tracks associated with these localized deposits are not radial. Within the area of the bone from which the tracks emanate, they have a completely random orientation. This is shown by the photo-

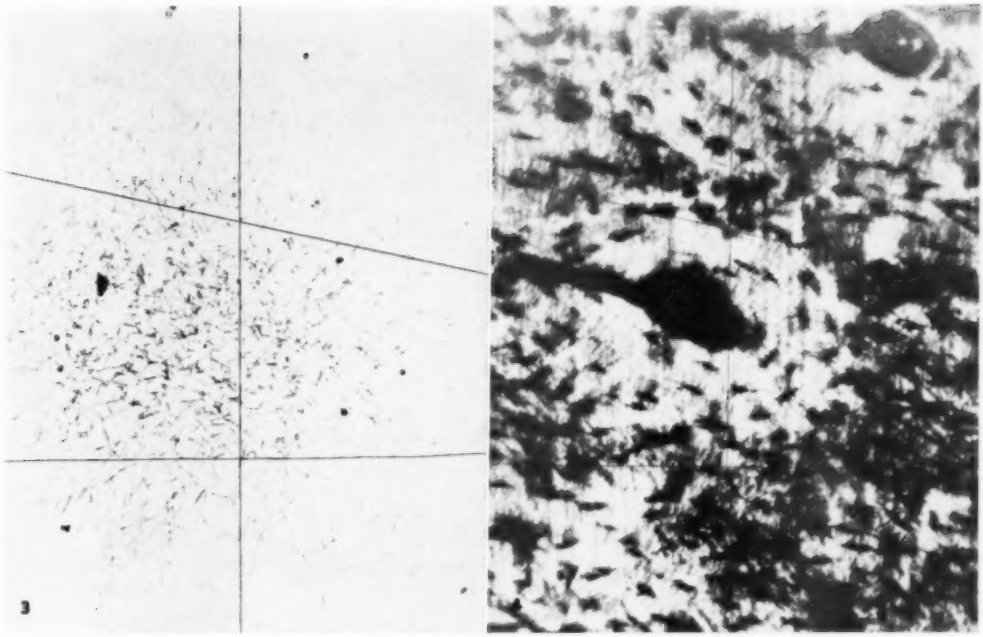


Fig. 3. Photomicrogram of alpha-particle track autoradiogram of section of human bone (E. E.). Exposure 423 hours. Magnification same as Fig. 1.

Fig. 4. Photomicrogram of portion of human bone section corresponding to autoradiogram in Fig. 3. Section was cut at point of bifurcation of haversian canal.

microgram of the alpha-particle autoradiogram (Fig. 1). The photomicrogram also shows that, within the source area, the distribution of alpha-particle tracks is very nearly uniform, which indicates a nearly uniform distribution of radium within this sharply limited area.

Figure 2 (E. E.) is a photomicrogram of that portion of the bone section which was recorded as an autoradiogram in Figure 1. The method of maintenance of exact registry used for the production of the autoradiograms permits a determination of the area from which the alpha-particles emanated. In these figures this area corresponds definitely to one haversian system. It may be clearly seen that the radium is nearly uniformly distributed within and almost completely limited to this haversian system. It may be seen also that there is a negligible amount of radium in adjacent systems.

In a total count of the haversian systems from various portions of several bone sections of this case (E. E.), it was found that 27 of the 278 systems contained radium. Thus, it may be seen that the radium is confined to approximately 10 per cent of the haversian systems of the bone, representing somewhat less than 10 per cent of the total bone, since no account was taken of the interstitial bone. If the same factor applies throughout the skeleton, this effect alone represents at least a ten-fold concentration of the radium in portions of the skeleton and a consequent ten-fold increase in the alpha-particle tissue dose to these parts. This effectively endows the radium with a ten-fold health hazard.

The course of an haversian system may be traced for a considerable distance longitudinally along the bone. This is accomplished by cutting serial sections between which not more than 150 microns of bone are lost. When this is done, it is found that the radium deposition follows the course of the haversian system. Fig-

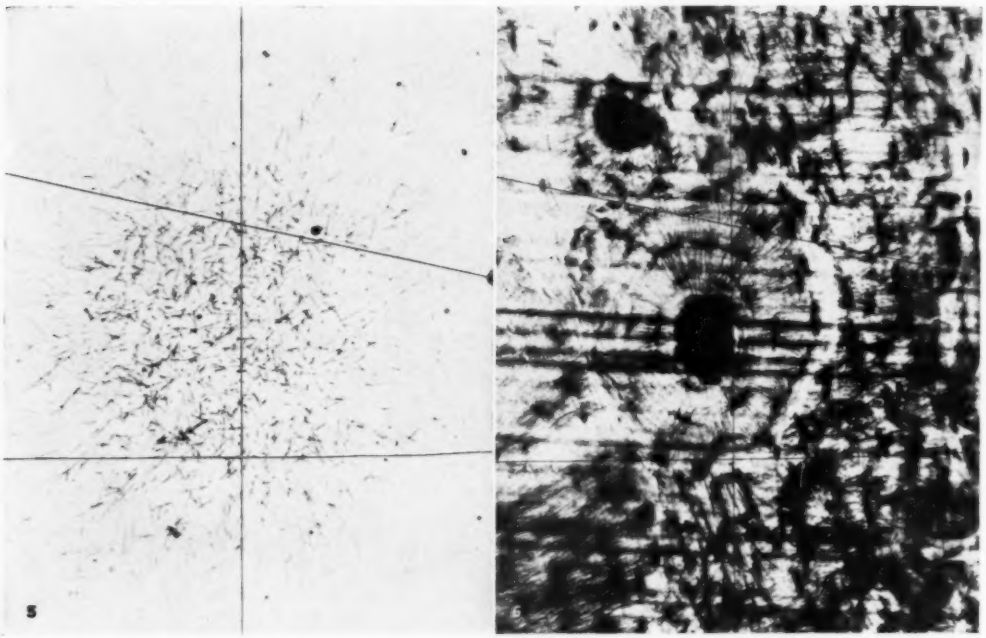


Fig. 5. Photomicrogram of alpha-particle track autoradiogram of section of human bone (E. E.). Exposure 423 hours. Magnification same as Fig. 1. Showing close association of alpha-particle tracks with one haversian system.

Fig. 6. Photomicrogram of portion of human bone section corresponding to autoradiogram in Fig. 5.

ures 2, 4, and 6 are photomicrograms of such serial sections. These observations lead to the conclusion that the radium deposit is encompassed by a cylindrical volume of bone throughout which the distribution is essentially uniform for distances of at least 2,000 microns. In Figure 4 the section was cut just at the point where the nutrient canal branched. The two branches are shown separate in Figure 6.

Figure 1 shows the alpha-particle pattern associated with the bone section of Figure 2. The radium is distributed as described above. Following the autoradiograms through Figures 3 and 5, one observes that the radium deposition does not follow the branches of the nutrient canal as might have been expected. It follows only one of the branches. The question then immediately suggests itself: Why does the radium concentrate in certain haversian systems and completely shun others? No clear-cut answer can be given to this question at present. The most likely explanation may be related to blood supply and radium concentration in the blood at the time the given haversian system was laid down.

Examination of numerous sections from the shaft of the femur from Case I. L. discloses the same type of localization as that found in Case E. E. The alpha-particle track distributions in association with certain haversian systems are similar in the two cases. It is notable, however, that in I. L. the localized deposits were much less numerous. In several instances, as will be shown below, the density of tracks in certain deposits was nearly as great in the bone of I. L. as in E. E. It has been determined that in the shaft bone of I. L. only 2.2 per cent of the haversian systems contained radium deposits as compared to approximately 10 per cent in E. E.

ALPHA-PARTICLE TISSUE DOSAGE

The radiobiological significance of a radium deposit depends upon the alpha-par-

ticle dose received by the vital elements of the tissue. This can be determined approximately by counting the number of alpha-particle tracks (N) associated with these localized deposits and by applying certain corrections and simplifying assumptions to this number. In order to express the tissue dose in rep (roentgens equivalent physical) per twenty-four hours, it is necessary to know also the duration of the autoradiographic exposure (τ), the area (A) of tissue from which the alpha particles were emitted, and the energy (E) of an average alpha particle.

The method used to calculate the approximate tissue dose is as follows. The number of alpha-particle tracks (N) produced during an exposure of τ hours, within a given area of the autoradiogram, is determined by counting the tracks on an enlargement of a photomicrogram of the autoradiogram or by use of a camera lucida. In either case, the over-all magnification is carefully determined. From this, the actual area, and hence the volume, from which the alpha-particles were emitted is determined. In several instances which involved the counting of tracks in very irregular areas, a piece of lead foil was carefully cut to fit the desired area on a camera lucida drawing made directly from the autoradiogram. The piece of lead foil was then weighed and the area determined from the weight per square centimeter.

The volume of bone tissue in which these alpha particles originated is taken as the product of the measured area and a thickness equal to the range of an average alpha particle in bone. This is a very difficult quantity to measure accurately since bone is not a homogeneous substance, either microscopically or as seen by an alpha particle. It is also exceedingly difficult to cut large sections of bone sufficiently thin to permit the passage of alpha particles. Some preliminary measurements made in this manner, however, indicate an approximate range of 32 microns for a 5.68 mev alpha particle.

The range of an average alpha particle cannot be expressed accurately because we do not yet know what fraction of the radon, produced in the bone section, actually escapes from the bone. The average energy of this alpha particle obviously depends upon what portion of the radon remains in the bone and produces alpha-particle emitting disintegration products there. Until experimental work, now in progress, can give a precise answer to this question, an average energy based on an assumed 50 per cent radon loss will be used.

The number (N) of alpha-particle tracks does not give directly the number of alpha particles *emitted* in the above defined volume. The number of *emitted* alpha particles can, however, be determined from N by correcting for those particles which do not reach the nuclear track emulsion because of the depth of their source and their large angle of emission. If we take the range (R) of an average alpha particle in bone as 32 microns, then it is clear that particles originating at a depth of slightly less than 32 microns will not produce a track in the emulsion unless their paths make a very small angle with the perpendicular to the nuclear track plate. Particles originating at this depth and traveling in a direction making a large angle with the perpendicular will be entirely absorbed in the bone. When this angle is more than 90 degrees, the particles are actually traveling away from the plate.

The ratio of the number of alpha-particle tracks to the number of alpha particles *emitted* within the volume of bone under consideration can be determined by making the simplifying assumption that bone is a homogeneous substance and that the radioactive material is uniformly distributed. Only particles having paths in the material shorter than their range will be registered by the emulsion. Consider a point source A (Fig. 11) at a depth x less than R, the range in bone. Particles from point A must be emitted within a cone defined by angle α such that $R \cos \alpha = x$, in order to produce tracks. This cone will then have a solid angle Ω such that $\Omega(x) = 2\pi(1 - \cos \alpha) = 2\pi[1 - (x/R)]$.

TABLE I: ALPHA PARTICLE TISSUE DOSE DATA

Case Identification	Exposure Hours	Number of Tracks Counted	Area of Source (sq. microns)	Tissue Dose (rep/day)
E. E. (Total Ra estimated at autopsy, 50 μgm.)				
Shaft of femur				
0575	423	408	1.1×10^4	23
0557 (Fig. 1)	423	950	2.5×10^4	23
0559 (Fig. 3)	423	1145	4.5×10^4	16
0561 (Fig. 5)	423	1012	4.5×10^4	14
0563	423	1414	4.5×10^4	20
0592 (Fig. 7)	423	70	3.6×10^3	12
0572	423	441	2.5×10^4	10
0603	212	202	2.5×10^4	10
I. L. (Total Ra estimated at autopsy, 8 μgm.)				
Shaft of femur				
0604	429	291	18×10^4	1.0
0613	429	1121	18×10^4	4.1
CL 322	405	528	16.4×10^4	1.9
CL 319	405	108	2.5×10^4	2.7
CL	405	443	11.0×10^4	2.6
0609	405	540	18.1×10^4	1.9
0605	405	291	18.1×10^4	1.0
Epiphysis of femur				
0577	429	1958	18×10^4	6.6
0617 (Fig. 10)	405	240	1.1×10^4	14.0
0583	429	2465	18.1×10^4	8.3
0581	429	1594	18.1×10^4	5.3
0585	429	1368	18.1×10^4	4.5
0587	429	1848	18.1×10^4	6.1

Since all directions of emission are equally probable, the probability that any particle emitted from a depth x will produce a track is

$$P(x) = \frac{\Omega(x)}{4} = \frac{R - x}{2R}$$

This probability obviously falls to zero when $x = R$. As a consequence of uniform distribution, the average or total probability that a particle emitted somewhere in a layer of depth R of the bone will produce a track has the value

$$P = \frac{1}{R}\int_0^R P(x)\,dx = \frac{1}{R}\int_0^R \frac{R - x}{2R}\,dx = \frac{1}{4}.$$

This is the fraction sought and simply means that if N is the number of tracks counted, the corresponding number of emitted alpha particles is $4N$.

On the basis of the above assumptions and corrections, the alpha-particle tissue dose is calculated as follows:

Let N be the number of tracks counted in A square microns for an exposure of τ hours; then $4N \times 24/\tau$ is the total number of alpha particles *emitted* per twenty-four hour period. The volume of bone is AR cubic microns, and if the density of bone is taken as 1.25, the mass of bone is $1.25\ A \times R \times 10^{-12}$ grams. The average energy of the alpha particles is 5.68 mev and, since one roentgen corresponds to the dissipation of 52.4×10^6 mev per gram, we have the tissue dose given by

$$\frac{4 \times 24 \times 5.68N}{1.25 \times 32 \times 10^{-12} A \times 52.4 \times 10^6 \tau} = \frac{2.61N \times 10^5}{\tau A}\ \frac{\text{rep}}{\text{day}}.$$

In order to illustrate the magnitudes of alpha-particle tissue doses encountered in these studies, a number of data are included in Table I. As indicated in the table, several of the examples refer to the areas in bone sections used as figures in this article. It should, of course, be made clear that these examples represent some of the larger concentrations. This does not mean, however, that those listed in Table I are the largest found nor that these are the only ones found. The selection has been influenced to a considerable extent by considerations of reproducibility in printing and by bone structural features.

Table I has been included largely to in-

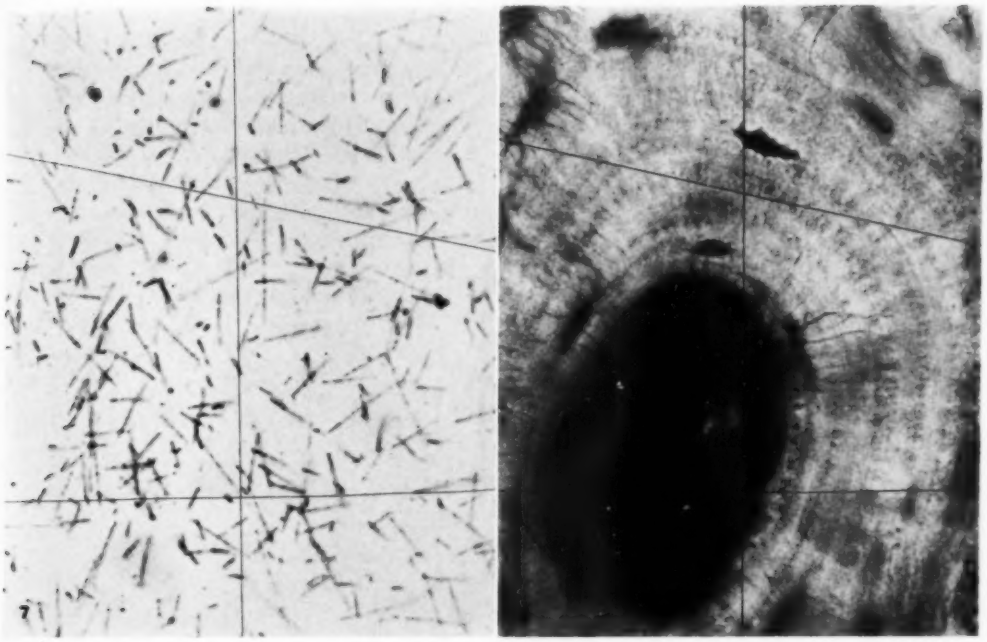


Fig. 7. High-power photomicrogram of alpha-particle autoradiogram of section of human bone (E. E.). Distance between intersection of horizontal lines with vertical line, 76 microns. Exposure 423 hours.
Fig. 8. Photomicrogram of portion of human bone section corresponding to autoradiogram in Fig. 7. Magnification same as Fig. 7. Note lacunae without canaliculi.

dicate the maximum tissue doses associated with the localized radium deposits in the different types of bone examined, and in the two cases. These data must *not* be taken to indicate the relative average densities since, in determining the average density, the frequency of the heavy concentrations must also be taken into account.

In the case of I. L., three types of bone have been studied: portions from the shaft of the femur, from the epiphysis of the femur, and from the ischial tuberosity of the pubic bone. The sarcoma was found at autopsy to have originated in the ascending and descending rami of the os pubis. When we compare the maximum densities of radium (as indicated by the number of tracks per unit area), we find the densities in the periosteal portion of the os pubis to be about 1.5 times as great as in the shaft portion of the femur. Approximately the same factor applies between the epiphyseal portion of the femur and the shaft. However, in the shaft portion, only about 2 per cent of the haversian systems contain radium, as compared with about 50 per cent in the os pubis. Thus the average density of radium in the portions of the pubic bone studied is about thirty-five times as great as in the shaft of the femur. It is difficult to make such a comparison in the case of the epiphyseal bone because of absence of organization into haversian systems.

For comparing the same types of bone from the two cases, only shaft bone was available. In E. E. the concentrations in the haversian systems seem to be about six times as dense as those in I. L. When compared with the ratio of the total estimated radium burdens at autopsy, this figure gives a deceptively good impression. However, when we take into account, also, the relative frequency of the deposits, we find the deposits in E. E. about 4.5 times as great. When both these factors are taken into account, it appears that E. E. should

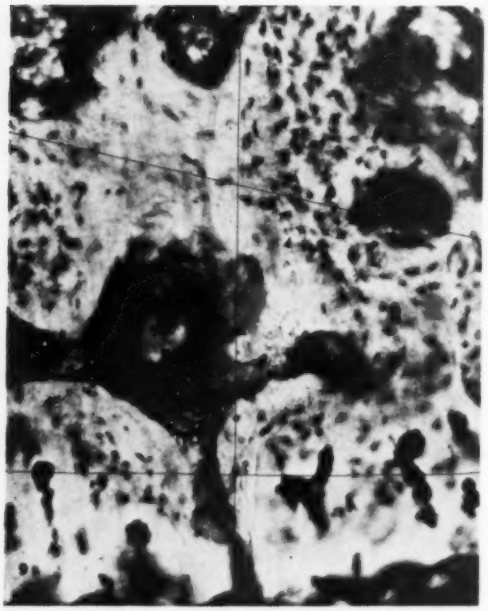


Fig. 9. Photomicrogram of section from epiphysis of femur (I. L.). Magnification same as Fig. 1.

have contained about 27 times as much radium as I. L. if deposits occurred in other bones in the same relative densities.

It is not by any means meant to suggest that we believe the factor of 27 did apply between these cases. The figures quoted are not based on accurate statistical studies and undoubtedly embody considerable inaccuracies. However, the disagreement between this factor and that obtained from the ratio of autopsy estimates is not particularly surprising when one recalls the great dependence of density on type of bone and hence the dependence of the estimate on the size and source of bone sample or samples used as the basis of the estimate.

Doses of the magnitudes shown in Table I would require long periods of time to produce biological changes, but there can be little doubt that such changes would eventually occur. Very little, if any, information is available relating biological effect to x-ray tissue dose in bone. It is known that bone in the neighborhood of a neoplasm which is given a therapeutic dose of x-rays frequently undergoes necrosis, but it is rarely possible to estimate the tissue dose to the bone in such cases.

In these cases of osteogenic sarcoma attributed to radium poisoning we have the distinct advantage of knowing that biological changes in bone did occur if these sarcomas were indeed radium-induced. In addition to this, we have what appears to

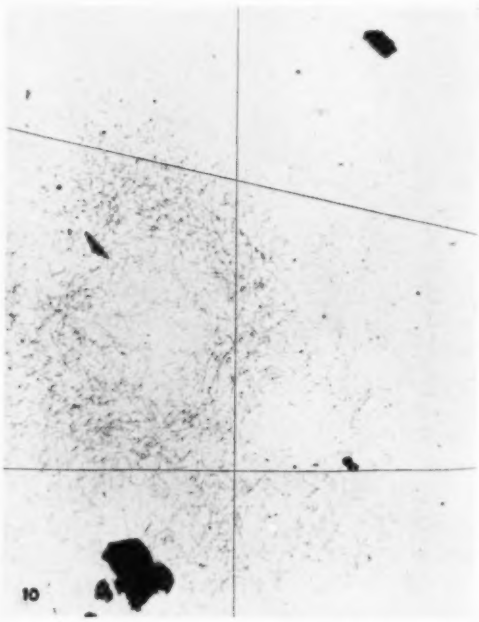


Fig. 10. Photomicrogram of autoradiogram in contact with portion of bone section of Fig. 9. Exposure 405 hours. Magnification same as Fig. 9. Note the close relation between structural details of bone matrix and the alpha-particle track pattern.

be microscopic evidence of necrotic areas in the bones of both of the patients described here.

Figure 8 (E. E.) is a high-power photomicrogram of a small portion of the bone shown in Figure 1. We are able to observe several lacunae which show no evidence of canaliculi. This probably means that the osteocytes in these lacunae had been killed and that this region of the bone was necrotic. The alpha-particle tissue dose in this region was calculated as approximately 10 rep per day (Fig. 7).

Figure 9 is a photomicrogram of a

section cut from the epiphyseal portion of the femur of case I. L. Figure 10 shows the manner in which the alpha-particle tracks demonstrate localization of the radium in conformity with the bone structure. Notable in Figure 9 is the structural disorganization in this region. In fact, that portion of the bone which coincides with the radium deposit appears to be almost devoid of the structure ordinarily found in human bone, namely, evenly distributed lacunae. Numerous instances of this have been found and are believed to be necrotic areas. The calculated tissue dose in this region was 14 rep per day.

Numerous sections have been taken from the pubic bone in the general region of the origin of the osteogenic sarcoma. The observed structural disorganization and evidences of resorption in progress may have significance in relation to the development of the sarcoma. Obviously this cannot be proved.

It is of considerable interest that autoradiographic examinations of portions of the mineral residue of the sarcoma revealed a negligible amount of radium in the sarcoma. This might possibly have been expected from the fact that the sarcoma developed several years after the termination of exposure to radium at a time when the mobile radium in the body would have had a low concentration. It does, however, indicate that radium is not mobilized from other portions of the skeleton, even though this might be expected to happen if radium were biochemically similar to calcium in bodily metabolism. In fact, microscopic examination of sections from several bones of this case show evidences of bone resorption and other indications of calcium deficiency ordinarily associated with rickets. This may have resulted from an attempt by the body to mobilize calcium to supply the needs of the rapidly proliferating sarcoma. It is notable, however, that the radium does not seem to have been disturbed in the areas from which the calcium appears to have been removed. This, along with the absence of radium in the mineral residue of the sarcoma, would appear to indicate that radium is not in every respect biochemically similar to calcium.

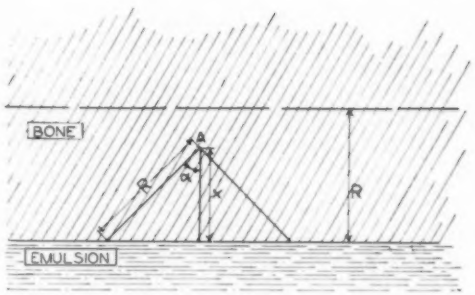


Fig. 11. Diagram of geometrical relations used in calculation of alpha-particle tissue dose from number of tracks counted.

SUMMARY

Portions of several different bones from two cases of osteogenic sarcoma attributed to radioactive substances in the bones have been examined microscopically and autoradiographically. The radioactive substances (chiefly radium and its disintegration products) are found to be concentrated in numerous microscopic localizations. The maximum density of radium in these localizations appears to vary by a factor of only about 1.5 from one type of bone to another, but the frequency of occurrence of these localizations may vary by a factor of nearly 25. Certain regions of some bones may be entirely devoid of radium. The mineral residue of the sarcoma of one case (I. L.) contained only a negligible amount of radium. This is believed to indicate that radium was not mobilized from other portions of the body, although this apparently did occur in the case of calcium. This is interpreted as one line of evidence to indicate that radium is not biochemically similar to calcium in all respects.

NOTE: The authors wish to express their indebtedness to Dr. G. Failla for his interest in this work and for his valuable suggestions and criticisms. The work was sponsored by the Office of Naval Research under contract N6 onr 260-T.O.I.

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SUMARIO

Estudios del Radio en los Huesos Humanos

Porciones de varios distintos huesos procedentes de dos casos de sarcoma osteógeno imputado a la acción de sustancias radioactivas en los huesos fueron examinadas microscópica y autorradiográficamente. Las sustancias radioactivas (principalmente radio y productos de la desintegración del mismo) estaban, según reveló el microscopio, concentradas en numerosos sitios. La condensación máxima del radio en dichos sitios no parece variar más que en un factor aproximado de 1.5 de una clase de hueso a otra, pero la frecuencia de esas localizaciones puede variar en un factor casi de 25. Ciertas regiones de algunos huesos pueden hallarse absolutamente desprovistas de radio. El residuo mineral del sarcoma en un caso no contenía más que una cantidad menospreciable de radio, lo cual, según parece, indica que no se movilizó radio de otras partes del cuerpo, aunque esto sucedió aparentemente en lo relativo a calcio. Lo anterior es interpretado como dato indicativo de que el radio no es bioquímicamente similar al calcio en todos sentidos.

Use of Autoradiographs to Detect Defects in Radium Needles and Tubes and Inequalities in the Distribution of the Radium[1]

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IT IS NOW WELL RECOGNIZED by most radiation therapists that careful preliminary planning and dosage calculations are essential to good radium therapy. Dosage systems have been published by Quimby (5) and Paterson and Parker (3, 4), which provide rules for the proper distribution of radium sources, and tables and charts for calculating the dosage. These dosage systems are based for the most part on the assumption that the radium sources used are free of defects and that the radium is uniformly distributed along the active length of the source. Badly packed needles, damaged containers permitting leakage of the radium, and faulty distribution of the radium may produce considerable discrepancies in the expected tissue dose as calculated for an assumed uniform packing. It would seem important, therefore, for those employing radium, first to study their radium supply to assure themselves that their sources are properly packed and of the strength and filtration designated by the manufacturer.

It is the purpose of this paper to describe a simple method of making autoradiographs of radium needles and tubes which can be carried out by anyone acquainted with the fundamentals of radiography and to present illustrations of defects and inequalities of radium distribution, which seem to emphasize the importance of such a study.

Certificates regarding the purity and quantity of the radium are usually supplied by the manufacturer or can be obtained from the U. S. Bureau of Standards. Such certificates are often taken as assurance that all sources are of the stated strength and filtration. However, in order to decrease the cost of measuring the radium content of sources and reduce exposure hazards in handling, it has been the practice of the U. S. Bureau of Standards to measure several radium sources of similar active length and content as a group rather than individually. For instance, ten radium needles of a stated strength of 2 mg. each and 3 cm. active length may be measured together, and a certificate supplied stating that the total radium content of the ten needles is 20 mg. Such a certificate does not necessarily indicate that each of the needles is 2 mg. strength, or that the radium is uniformly packed along its active length.

This additional information can be obtained by making autoradiographs of each radium needle and tube. Technics have been described by Griffith (2) and by Russ and Clephan (6) for making autoradiographs, and Clephan (1) has published a suitable formula which can be used as a guide for determining the exposure time required for needles and tubes of varying strengths, diameter, active length, and filtration, with a constant multiplication factor based on the speed of the film emulsion used.

This formula is as follows:

$$T = \frac{10(1 + S)^2}{M} \times L\sqrt{D}$$

where

M = radium content in milligrams
L = active length in centimeters
S = screenage or wall thickness in millimeters of platinum
D = diameter of bore in millimeters
T = calculated time of exposure in seconds.

The factor 10 represents the constant

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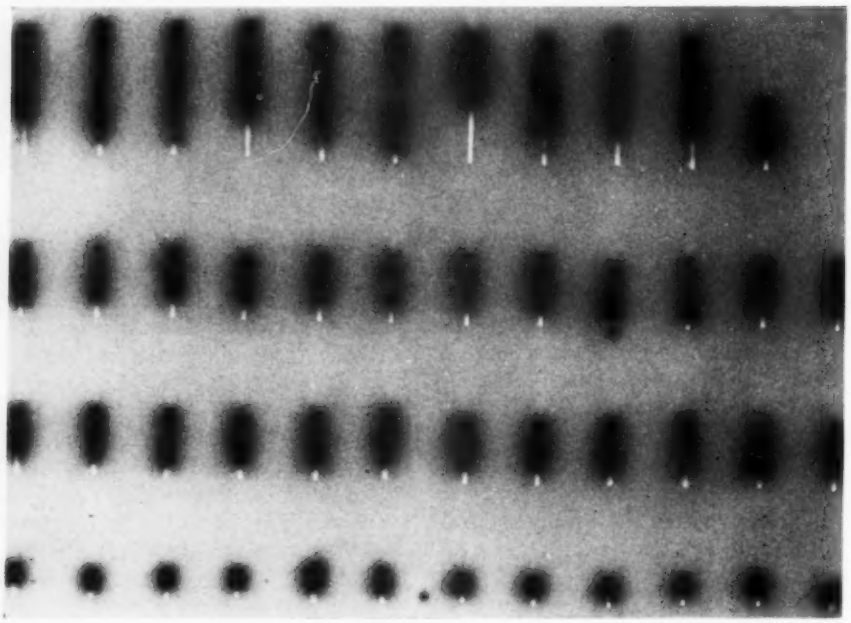

Fig. 1. Autoradiograph of a supply of poorly packed radium needles showing rather marked inequalities in radium distribution.

suitable with the use of Ilflex films, whose emulsion speed appears to be similar to that of Eastman non-screen film.

The technic which we have found to produce satisfactory autoradiographs is simple and easy to carry out and requires no material other than that available in any department of radiology. The radium holder is made by cutting slots of the size of the radium needles or tubes in a piece of cardboard obtained from a film package. Two strips of ordinary Scotch tape are pasted over the underside of these slots to prevent the radium sources from dropping out of their respective slots when the holder is moved. The adhesive base also prevents the sources from rolling about if the slots are slightly large in size.

Working behind a lead protective shield, the radium sources are placed in the various cardboard slots. This radium holder is then transported to one of the radiographic rooms on a long-handled carrier or cart, advantage being taken of distance, wherever possible, to keep the exposure of the individual handling the radium within the recommended permissible dose level of 6.25 milliroentgens per hour. Preliminary dosage calculations are made by the inverse-square law for the particular quantity of radium being handled, so that the dose level at the working distance is known at all times.

A film wrapped in black paper is centered beneath the x-ray tube on the radiographic table. The radium holder is then brought into the radiographic room, which is darkened except for suitable safe lights. The black paper is removed from the film and the holder placed directly in contact with the film. Eastman Kodak screen film was used in our studies and the formula as published by Clephan was utilized for determining a suitable exposure time, assuming a constant multiplication factor of 20.

After the desired exposure has been made, the radium holder is returned to the radium room and the film is developed for five minutes at 68° F.

Any needles or tubes which appear to be defective or show a marked inequality of

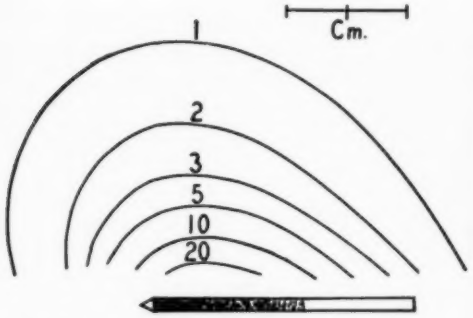

Fig. 2. Distortion of the isodose curves, in gamma roentgens per hour, about a 2-mg. needle, resulting from a faulty radium distribution.

radium distribution are identified by their respective positions on the autoradiograph and radium holder. These are removed and tagged as unsatisfactory for clinical use before being placed back in the radium safe. They are later returned to one of the radium companies for reconversion.

An autoradiograph of a supply of needles showing rather marked inequalities of distribution is shown in Figure 1. There is an undesirable variation in the strength of needles of similar active length and in the uniformity of the distribution along this active length. Leakage can be seen occurring from the broken end of one of these needles.

Variations in the uniformity of the radium packing causes a marked distortion of the radiation distribution in relation to the needle, as shown by the isodose curves about one of these needles (Fig. 2). These needles were prepared many years ago, before suitable packing technics had been devised.

The more modern methods of loading, particularly the cell method, tend to reduce the chance for errors in packing. Autoradiographs of some suitable cell-filled and direct-filled needles and tubes are shown in Figure 3.

The high intensity about the lowermost needle is largely due to unfiltered beta radiation passing through the 0.2-mm. platinum filter. This type of low-filtered, high-intensity needle was used years ago in interstitial therapy, but it was soon found

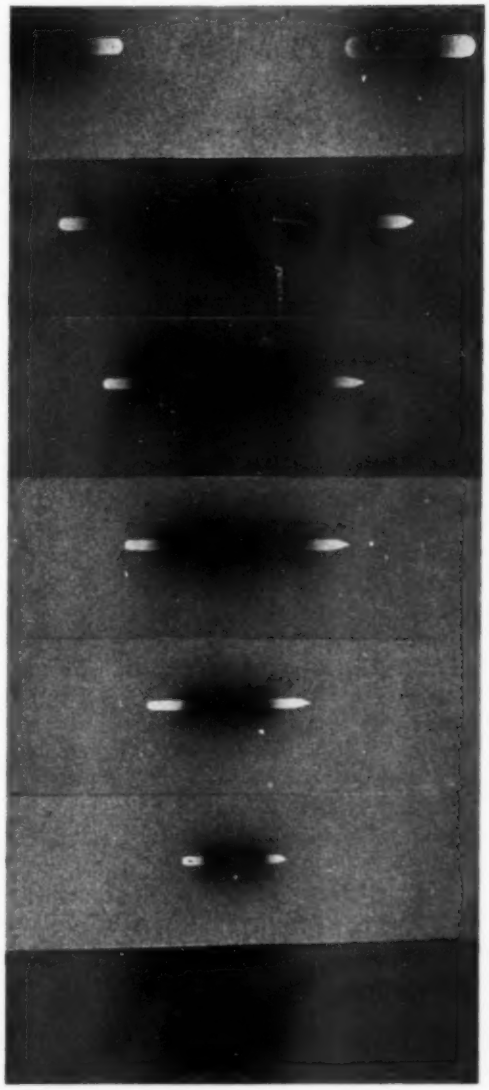

Fig. 3. Autoradiograph of cell-filled and direct-filled needles and tubes with satisfactory radium distribution.

that the high dose along the needle track led to excessive necrosis in the immediately adjacent tissue and prevented the delivery of adequate radiation to more remote tissues. This practice has now been almost universally abandoned in favor of low-intensity needles with a linear strength of not over 1 mg. per centimeter of active length, and a wall thickness of 0.5 mm.

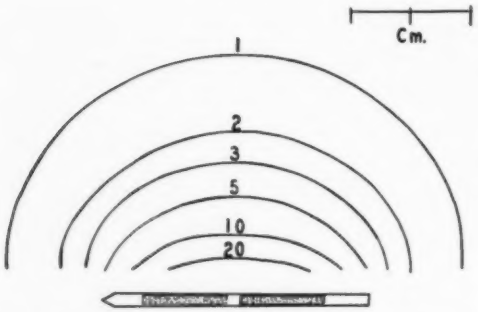

Fig. 4. Isodose curves in gamma roentgens per hour about a 2-mg. cell-filled needle of 3 cm. active length, with satisfactory radium distribution.

platinum. This filtration is sufficient to remove all of the beta radiation.

Higher filtrations have been advocated, but they tend to increase unduly the bulk of the needle, and the additional improvement in distribution and quality of the radiation does not appear to influence the biological effect.

The isodose curves about two low-intensity cell-filled radium needles, with uniform packing, are shown in Figures 4 and 5. Needles of this type give the most satisfactory results in interstitial therapy.

SUMMARY AND CONCLUSIONS

Autoradiography is an important and useful method of testing radium preparations for defects and uniformity of packing. Certificates, as issued by the manufacturer or by the U. S. Bureau of Standards, serve as a guarantee of the purity and quantity of radium, but do not give the purchaser any assurance regarding the uniformity of packing, and in some cases do not necessarily indicate the strength of the individual sources. This additional information can be obtained through autoradiographs.

A simple method of making autoradiographs of radium sources is described, with illustrations of poor radium distribution and satisfactory radium distribution in direct or cell-filled needles. Diagrams of the isodose pattern about a needle with poor radium distribution and two needles with uniform distribution are included to demonstrate further the importance of proper radium packing.

Physicians using or supervising the use of radium in radiation therapy should study their radium supply at intervals of five to ten years to reassure themselves that their radium sources are free of defects, uniformly packed, and of the stated strength and filtration designated by the manufacturer. Purchasers of radium in the future should insist upon a guarantee relating to distribution of the radium in the needles and tubes, as well as upon certificates of purity and quantity.

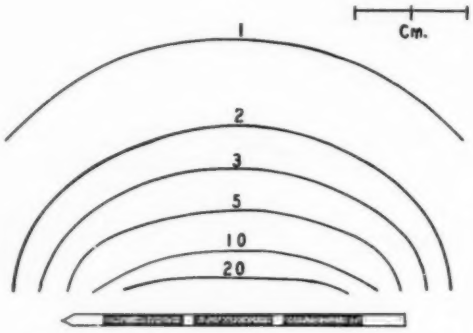

Fig. 5. Isodose curves in gamma roentgens per hour about a 3-mg. cell-filled needle of 4.5 cm. active length, with satisfactory radium distribution.

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SUMARIO

Empleo de Autorradiografías para Descubrir Imperfecciones en las Agujas y los Tubos de Radio y Desigualdades en la Distribución del Radio

La autorradiografía suministra un método útil para comprobar las fuentes de radio (agujas y tubos) en busca de imperfecciones y determinar la uniformidad del empaque. Los certificados expedidos por el fabricante o por la Oficina de Normas de los E.U.A. constituyen una garantía de la pureza y la cantidad del radio, pero no ofrecen al comprador la menor seguridad acerca de la uniformidad del empaque, y en algunos casos, tampoco indican forzosamente la potencia de una fuente dada. Esta información complementaria puede obtenerse por medio de autorradiografías.

Se construye un portarradio haciendo ranuras del tamaño de las agujas o los tubos en un pedazo de cartón y pegándoles debajo dos tiras de hiladillo. Con las precauciones del caso, se lleva el portarradio a la sala de radiografía donde se pone en contacto directo con una película a fin de obtener el tiempo de exposición deseado, según indica una fórmula publicada originalmente por Clephan. Al revelar la radiografía, se identifican por sus posiciones respectivas en la autorradiografía y el portarradio las agujas y los tubos que parecen defectuosos o que muestran pronunciada desigualdad en la distribución de radio.

A fin de demostrar mejor la importancia del debido empaque del radio, se ofrecen diagramas del patrón de isodosis para una aguja que tiene el radio mal distribuído y para dos agujas en las que la distribución es uniforme.

The Gynograph, A New Improved Gynoroentgenologic Apparatus for Use in Conjunction with Fluoroscopy and Radiography of the Female Genital Tract[1]

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IN RECENT YEARS, owing to improved radiopaque media, refinements in technic, and greater selectivity of patients, uterosalpingography has come into more frequent use. Whether the procedure is performed by the roentgenologist or gynecologist or both, the instillation of a foreign material into the uterus and fallopian tubes is not without danger. Reports have appeared of such complications as intravasation of the venous sinuses of the uterus, pulmonary emboli, foreign body retention cysts, pelvic peritonitis, rupture of the fallopian tube, and even death.

In order to minimize the dangers and, at the same time, obtain satisfactory diagnoses, the present writer has developed an apparatus now known as the *Gynograph* (Fig. 1) which has been used to good advantage in recent years by both gynecologist and radiologist.[2] With this apparatus he has performed over 2,000 uterotubal x-ray series without a single one of the above-mentioned complications. In fact, aside from an occasional rare flare-up of an old chronic salpingitis, the procedure of hysterosalpingography can now be said to be practically free from complications.

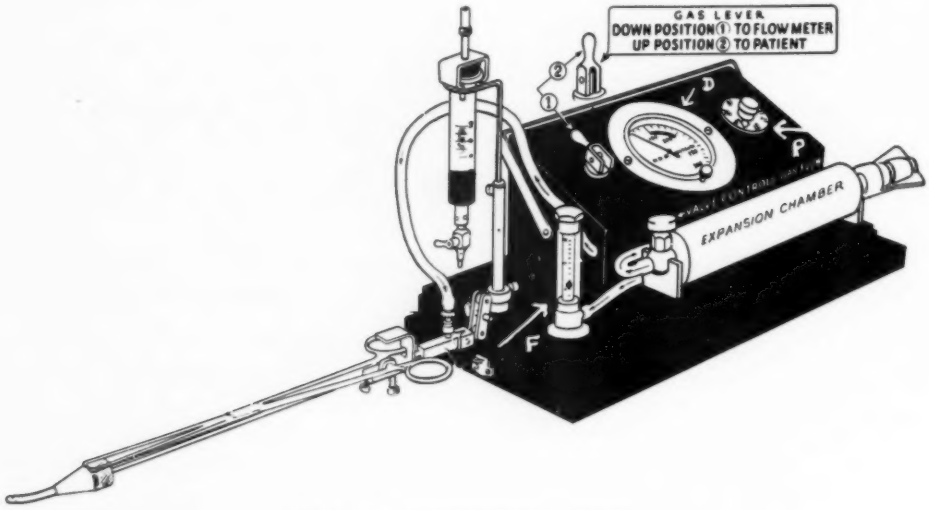

Fig. 1. The new improved Gynograph.

BASIC PRINCIPLES

1. Preparation of Patient: Prior to hysterosalpingography, the patient should be carefully examined to rule out possible pelvic disease. If there is any doubt, a

[1] From the Sterility Clinic of the Department of Obstetrics and Gynecology of the Metropolitan Hospital, New York, N. Y. Accepted for publication in May 1950.

[2] The Gynograph is accepted by the Council of Physical Medicine of the American Medical Association. It is manufactured by Goodman-Kleiner Co., New York, N. Y.

sedimentation blood test and blood count should be taken to exclude a low-grade chronic salpingitis. The ideal time for the procedure is about four to six days after the cessation of the menses, when the endometrium is in its resting phase. Antispasmodic premedication is of great value. A preliminary enema and vaginal douche should be routine.

2. Choice of a Radiopaque Substance. The writer has found Iodochlorol (Searle) to be the most satisfactory medium for hysterosalpingography. It yields excellent radiographs but requires some weeks for total absorption from the peritoneal cavity.

3. Choice of a Technic. Any technic for instillation of a radiopaque medium into the uterus, to be safe, must include manometric control of pressure, continuous fluoroscopy, and the use of minimal amounts of foreign material. The technic which the present writer employs is described below.

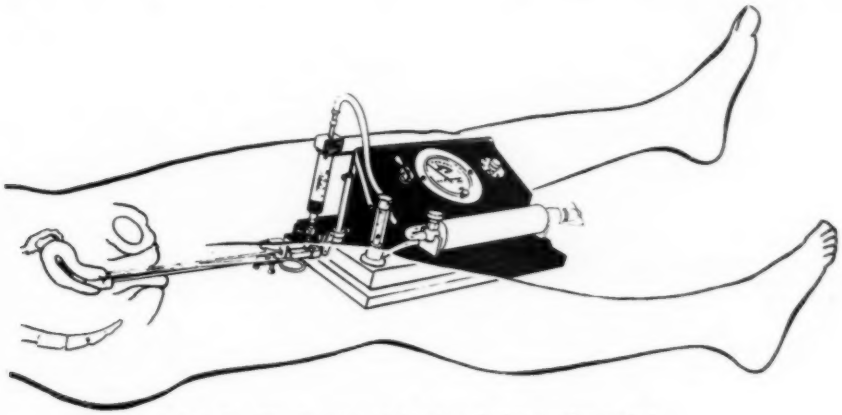

Fig. 2. The Gynograph in place during testing period.

GYNOGRAPHIC SURVEY

An ideal method of surveying the female genital tract employs a combined gaseous and radiologic technic (1). A preliminary gaseous insufflation is performed, followed by the instillation of small amounts of the opaque substance, succeeded, in turn, by a second insufflation of gas (carbon dioxide). The preliminary gas instillation furnishes immediate information as to the status of the fallopian tubes. If patency is established, the injection of the viscid opaque substance can follow with impunity. If no gas enters the tubes, extreme care should be taken when instilling the foreign radiopaque material. The secondary gaseous instillation serves to eliminate the use of excessive oil by pushing the opaque material before it. By a simple switch-off, gas can be substituted for oil and *vice versa*. In addition to being safe, expedient, and accurate, the technic employing the Gynograph eliminates the necessity for the twenty-four-hour proof or follow-up control film.

The procedure is divided into three stages which follow one another without interruption. The flow of gas (as determined by a flowmeter) continues at the same rate throughout all three stages. In the first stage the gas supply is directly connected to the uterine cannula. For oil instillation, it is connected to the oil reservoir and forces the oil into the uterus through the cannula. In the final stage, the oil reservoir is removed from the circuit and gas alone is allowed to enter the uterine cavity.

Stage 1: With the patient in the lithotomy position on the x-ray table, a specially devised self-retaining cannula (which is an incorporated part of the Gynograph) is

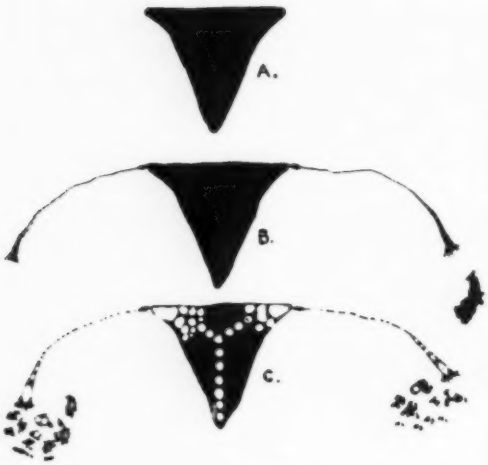

Fig. 3. Schematic drawings of uterotubal tract. A. Uterine cavity filled with opaque material. B. Uterus and tubes filled. C. Effect of secondary gaseous insufflation (dispersion of medium, eliminating need of twenty-four-hour film).

introduced into the cervical canal and attached to a tenaculum, thus releasing the operator's hands for fluoroscopy, etc. With the cannula secured, the patient can assume a more comfortable supine position with legs extended. The Gynograph is then placed on the table between the patient's legs and connected directly to the self-retaining cannula (Fig. 2). The gas is released from the expansion chamber by turning a single valve. The flowmeter (Fig. 1, F) denotes the rate of gas flow. It is set at 20 to 30 c.c. per minute. The gas lever is then turned in the "up" position and the carbon dioxide enters the patient. Another dial (P), known as the Pressurtrol, sets the desired pressure, which is best maintained at 150–200 mm. mercury as seen on the air-plane manometer (D). Tubal patency is indicated by a drop followed by a rise of the manometer pointer. Fluoroscopy at this time will reveal a gradually enlarging gaseous area in the pelvis at each side of the mid-line. It is not necessary at this stage to expose a film. With the preliminary insufflation indicating some tubal patency, the second step is begun.

Stage 2: The 10-c.c. syringe, containing but 4 c.c. of iodized oil, is swung into place and connected to the cannula at one end and to the source of gas at its other end. The gas will be seen slowly displacing the oil from the syringe (oil reservoir) into the uterus (Fig. 1). As the oil enters the uterine cavity, under fluoroscopic observation, the latter will soon be seen as a triangular area. When this is outlined (usually requiring about 2 c.c. of oil), the first film is exposed (Fig. 3A). The oil continues to flow into the fallopian tubes, and fluoroscopic visualization informs the operator when enough has been instilled to fill both oviducts (Fig. 3B). A second film is then exposed. All during the flow of oil into the uterus and tubes the manometric pressures are in direct vision owing to the luminescent character of the dial. With the uterus and tubes filled, the physician is ready for the final insufflation.

Stage 3: The oil reservoir is now disconnected and the gas supply is once again directly connected to the uterine cannula. Under the fluoroscope, the oil will be seen dispersed from the fallopian tubes and spread about the pelvis (Fig. 3C). The use of gas reduces considerably the amount of radiopaque material instilled into the patient. Not more than 4 c.c. are required with each test (2). With dispersion of oil noted, the third and final x-ray film is exposed. When the test is completed, and the instruments are removed, the patient will experience typical shoulder pains characteristic of gaseous penetration of the peritoneal cavity.

DISCUSSION

With the use of the Gynograph and the technic as outlined above, accidents and complications are brought down to a minimum. Owing to the fact that only 4 c.c. of iodized oil are required for the complete test, only small amounts remain in the peritoneal cavity to be absorbed. So simple is the technic that once it is witnessed or attempted, duplication can be accomplished with facility. The use of continual fluoroscopy together with the luminescence

of the Gynograph manometer dial insure the utmost of safety in evaluating the female genital tract.

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SUMARIO

El Ginógrafo, Nuevo Aparato Ginorroentgenológico Perfeccionado para Empleo Conjunto con la Radioscopia y la Radiografía del Tracto Genital Femenino

Al nuevo aparato perfeccionado aquí descrito para la histerosalpingografía se le llama Ginógrafo. El mismo facilita insuflación gaseosa preliminar, seguida de la instilación intrauterina de pequeñas cantidades de un medio opaco (el A. usa yodoclorol), la cual a su vez va seguida de otra insuflación de gas (bióxido de carbono). El procedimiento se lleva a cabo bajo observación roentgenoscópica, tomándose radiografías al llenarse el útero de aceite, al llenarse las trompas y, por fin, al dispersarse el aceite después de la última insuflación de gas.

El empleo del gas rebaja a un mínimo la cantidad de aceite requerida (no más de 4 cc. para cada prueba) y la continua observación radioscópica y la observación directa de la presión manométrica en una esfera luminosa constituyen otros factores de seguridad al determinar el estado del aparato genital femenino.

Uniform Contact Roentgen Therapy for Large Areas

A Simple Device and Method[1]

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CONTACT ROENTGEN therapy has certain inherent advantages due to the very short tissue-target distance and the relative low voltage employed. For the Philips contact tube these factors are 18 mm. distance and approximately 50 kv.p. This gives a source of intense irradiation of the order of 6,000 to 10,000 r per minute. The short tissue-target distance results in a very rapid falling off of intensity. The depth dose at 5 mm. is approximately 50 per cent of that at the surface, at 10 mm. 23 per cent, and at 40 mm. 1 per cent. The major disadvantage is that the tube aperture is only 2.5 cm. in diameter. Many thin lesions, both benign and malignant, such as hemangiomas, calluses, keloids, and some epitheliomas, for which the short tissue-target distance and low voltage would be advantageous, are too large for so limited a treatment field. Large-field contact therapy may also be desirable in cases in which the bulk of a tumor has been removed surgically, for intensive irradiation of the tumor base.

Two methods have been used in the contact treatment of large areas. One consists in moving the tube, while energizing it, over the area to be treated; in the other the tube is moved from spot to spot, in an attempt to cover the entire lesion. With these methods it is difficult, if not impossible, to get a uniform distribution of radiation (1–3).

In order to obtain uniform irradiation of a surface or plane, one of us (E. F. L.) has designed a grid containing squares measuring 1.5 × 1.5 cm. These are the largest squares which can be included within the 2.5 cm. round field of the tube. The grid consists of a sheet of lead, 22 × 22 cm., approximately 0.5 mm. thick, having an aperture in the center measuring 18 cm. on a side. A net is fashioned from nylon fishing line, having meshes 1.5 cm. square, the line being anchored to the lead by staples and stitches. Where the nylon lines cross, they are attached by passing a thread through the line and tying. This is done to avoid any distortion of the field, which is particularly important in treating uneven surfaces. This grid may be sterilized in any manner and used repeatedly. It furnishes uniform radiation to the surface and will fulfill most practical needs. For thicker lesions, in which it is desired to obtain uniform irradiation of other planes than the surface, the 1.5-cm. squares of the grid may be spaced at varying distances, depending upon the depth at which the uniform radiation is desired. For instance, for a plane 5 mm. below the surface, a spacing of 4 mm. is required. The radiation is not uniform below the plane of uniform irradiation because of the geometric spread resulting from the short target-tissue distance and subsequent overlap. The volume of tissue involved in this overlapping is, however, minimal (Fig. 1). Lead rubber can also be used for making the grid.

To treat one field at a time, a second thin piece of lead about 10 cm. square with an aperture measuring 1.5 × 1.5 cm. is used. In order to center the x-ray tube through the aperture accurately, a circle is marked on the lead corresponding to the circumference of the tube.

The method of practical application (Fig. 2) is as follows: An outline of the area to be treated is made on a sheet of cellophane with a wax pencil. This outline

[1] From the Department of Radiation Therapy, Cook County Hospital, Chicago, Ill. Accepted for publication in May 1950.

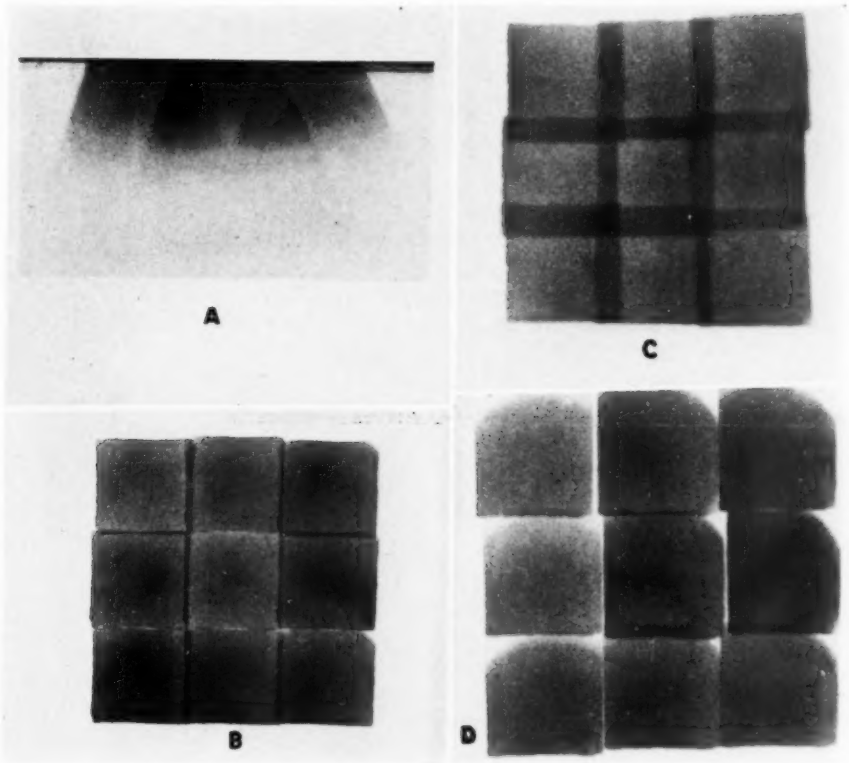

Fig. 1. Distribution of radiation with the nylon grid. A. Degree of overlap below the surface. B. Surface distribution. C. Distribution 5 mm. below the surface. D. Distribution 5 mm. below the surface with meshes spaced 4 mm. apart.

is then transferred to a piece of lead foil by means of carbon paper, and the outlined area is cut out of the foil. This is then laid over the lesion and fastened in place with adhesive, or in surgical cases with hemostats. Over this is placed the grid, which is likewise securely fastened. The lead piece with the 1.5-cm. square aperture is placed over successive meshes of the grid, and the desired x-ray dose is delivered to each area. We have been using this grid for about two years. The following case reports are illustrative.

CASE 1: An 8-week-old child had an extensive hemangioma 2 to 3 mm. thick, measuring about 6 × 8 cm., involving both upper eyelids and frontal regions. It had been present since birth and was growing rapidly. The infant was unable to open its eyes. Radiation was delivered to the entire lesion as described above. Within a short time the hemangioma began to fade, enabling the infant to open its eyes. No conjunctivitis nor epilation of the eyelashes was noted. At present (one year later) the lesion is much improved.

CASE 2: A 60-year-old male had a basal-cell carcinoma of the right cheek, dating back twenty years. Due to inadequate care, this had progressed until it involved the entire right half of the head, resulting in the loss of the right auricle and right eye. It measured about 12 × 25 cm. Biopsy disclosed a mixed basal-cell and squamous-cell carcinoma. Further surgical treatment was deemed impracticable. Although the entire area could have been irradiated at one sitting by means of the grid, it was thought advisable to divide the treatment into four sessions, with intervals of one week, about 25 meshes at each session. A total dose of 10,000 r was delivered to the entire lesion. The reaction was not severe. The area became cleaner, and the patient is still alive one year later.

Contact therapy has been used for treating the tumor bed after excision, particularly in the case of bladder tumors (4),

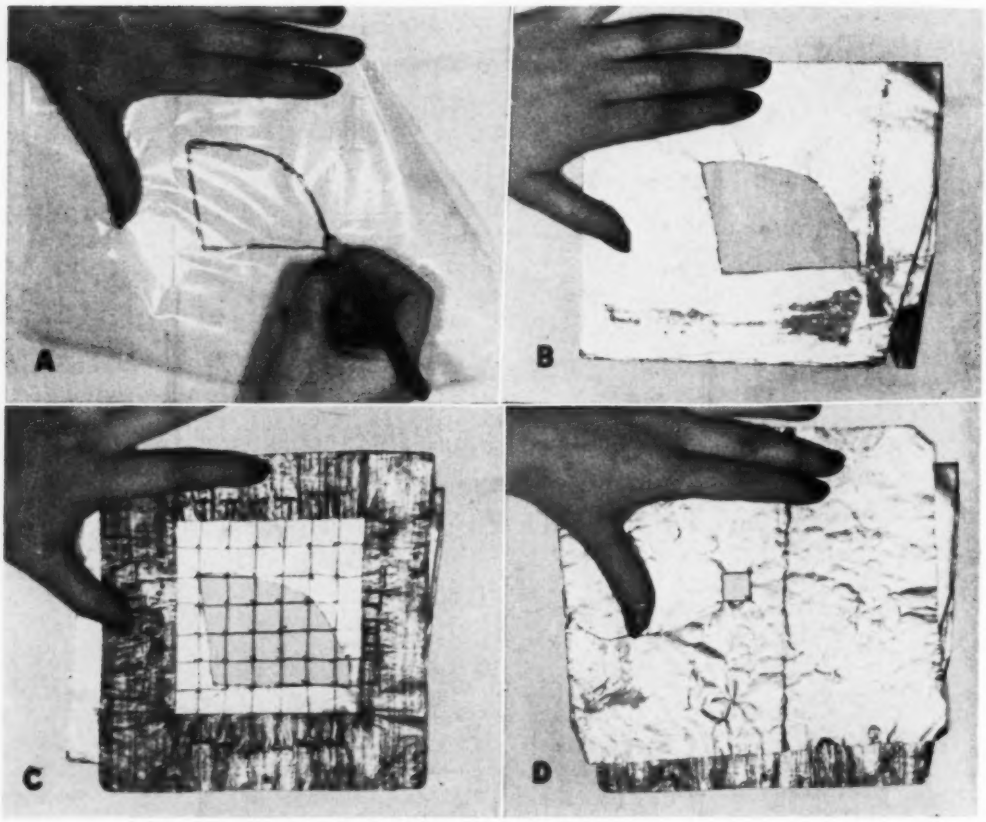

Fig. 2. Practical application of the nylon grid. A. Outlining the field to be treated. B. Lead cutout for field. C. Lead cutout with grid in place. D. Single mesh outlined with auxiliary lead, ready for treatment.

This technic seemed to warrant further exploration, and we have used it in the treatment of carcinoma of the breast and carcinomas involving the head and neck. Experiments were carried out at the Alexian Brothers' Hospital in Chicago by Dr. Michael Indovina and one of us (E. F. L.) on monkeys to determine the dosage which could be delivered by contact radiation to exposed subcutaneous tissues without disturbing the primary healing of the skin replaced over the irradiated tissue. As much as 20,000 r were given under sterile conditions to subcutaneous tissue in the dorsal region of the monkey, without signs of sloughing during a twelve-month follow-up period.

CASE 3: A 65-year-old female had a scirrhous carcinoma of the lower outer quadrant of the breast. The tumor measured about 5 cm. in diameter and was movable. No axillary nodes were palpable. Dr. H. A. Oberhelman, at the Mercy Hospital, did a simple mastectomy, leaving the pectoral muscle intact. Investigation of the axilla showed no involvement. An area about 5 × 11 cm. was treated by means of the grid, 6,000 r being delivered over the entire area. A drain was placed in the wound for twenty-four hours. Primary healing was completed in two weeks. Examination one and a half years later revealed no evidence of recurrence.

The same form of treatment has been carried out in association with Dr. Joseph Schaeffer and others in carcinomas of the head and neck requiring large resections, and we are continuing to investigate the possibility of using surgery and contact therapy in a variety of malignant conditions.

SUMMARY

A simple device is described, which makes it possible to employ contact roentgen therapy in accessible benign or malignant lesions, or lesions made accessible by surgery, measuring more than 2.5 cm. in diameter.

Three cases are cited to illustrate the application of this device.

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SUMARIO

Roentgenoterapia de Contacto Uniforme para Zonas Grandes

El sencillo accesorio aquí descrito permite emplear roentgenoterapia de contacto en las lesiones accesibles, ya benignas o malignas, y en las que la cirugía convierte en accesibles, siempre que unas u otras tengan más de 2.5 cm. de diámetro. El accesorio consiste en una rejilla de nilón con mallas de 1.5 cm.², adherida la misma a una lámina de plomo de unos 0.5 mm. de espesor, que mide 22 × 22 cm., y tiene en el centro una abertura de 18 cm.². Sobre mallas sucesivas de la rejilla se coloca otra lámina de plomo de unos 10 cm.², cuya abertura mide 1.5 × 1.5 cm., y se entrega a cada zona la dosis deseada de rayos X.

Cítanse 3 casos.

A Simple Method for the Direct Projection of a Section of a Roentgenogram Onto a Screen[1]

A. R. SHANDS, JR., M.D.[2], and FRANK P. STONE, M.D.[3]

THE DIRECT PROJECTION onto a screen of an entire roentgenogram or a portion of a roentgenogram is of interest and importance to all physicians who use roentgenograms for teaching or who wish an enlarged roentgenographic image for study. There are several projection reflecting apparatuses now on the market for this purpose; but most of these are expensive, permit only a limited enlargement, are not suitable for projection at a distance in a large auditorium, and do not utilize existing projection equipment.

The authors have developed a simple method for the projection of a section of a roentgenogram onto a screen through the utilization of a standard type of 1,000-watt bulb projection lantern and construction of a device for conveniently interposing the roentgenogram between the light source and projection lens (Fig. 1). Nothing is altered in the essential mechanism of the lantern. A thin 14 × 22-inch aluminum plate with a 3 × 4-inch aperture in approximately the middle of its upper half is used. Attached to the lower margin of this plate is a double base which, by means of a simple four-screw mechanism, allows the plate to be tilted in either direction or elevated. This plate is placed upon a table and serves as a support for the roentgenogram on one side and the projection lens and tube on the other. In some lanterns, the projection lens and tube with its attachment to the lantern can be separated from the main portion of the lantern (Fig. 1). When this is possible, the lens and tube can be fastened by screws to the aluminum plate in front of the aperture (Fig. 2). If this is not possible, it will be necessary to provide a new projection lens and tube with an attachment for this purpose.

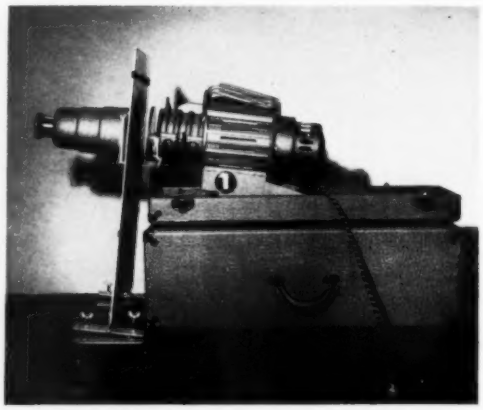

Fig. 1.—Projection lantern for roentgenograms showing (left to right) projection lens and tube, aluminum plate for the support of the roentgenogram, two circular pieces of 1/4-in. heat-absorbent glass in bracket attached to lantern, and main portion of lantern elevated on its carrying case. Note adjustable base for plate, which permits tilting and elevation of plate.

A section of a roentgenogram which is the size of a large lantern slide (3 × 4 in.) is centered over the aperture in the aluminum plate. With the projection lantern elevated to the height of this opening, the light rays of the 1,000-watt bulb will go through the film at this point and into the projection lens attached to the other side of the plate. This portion of the film then can be focussed onto the screen (Fig. 4). In some types of lanterns the attachment portion allows for the use of a slide carrier and adapter (Fig. 2), thus permitting the use of the same lantern for the projection of large (3 × 4-in.) and small (2 × 2-in.) slides.

In the development of the apparatus, it was found that, because of the absorption of heat from the light rays of the 1,000-watt lamp, the roentgenogram would wrinkle, crack, or even melt where it was

[1] From the Alfred I. duPont Institute of the Nemours Foundation, Wilmington, Del. Accepted for publication in May 1950.

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struck by the light, often after only a few seconds exposure. A large fan blowing directly onto this area would not lower the high temperature on the surface of the film enough to prevent this damage. In order not to injure the film, it was found necessary to add another filter for reducing the heat of the light rays to that furnished with the lantern. This was provided by either placing an ordinary laboratory jar with a blue solution of copper sulfate (Fig. 3) or

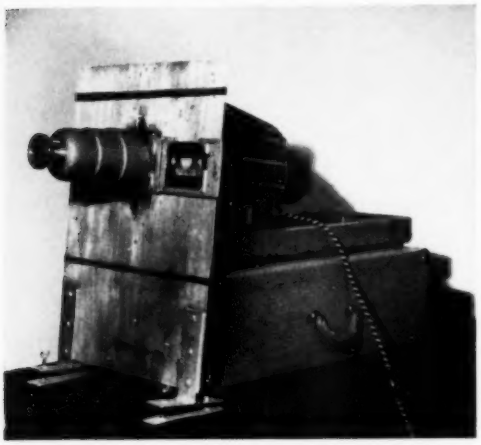

Fig. 2. Projection lantern for roentgenograms showing attachment of lens tube to aluminum plate with slide carrier in place. Note adjustable base and two large rubber bands around plate, which are used to hold the roentgenogram firmly against the plate on the opposite side.

by interposing two 1/4-in. pieces of blue heat-absorbent glass (Fig. 1) between the light source on the one side and the film to be projected on the other side. The copper sulfate solution or the special blue glass will almost completely absorb the infra-red rays or thermal portion of the spectrum and will result in only a minimum of heat over the exposed portion of the roentgenogram after five to ten minutes of exposure to the intense light. With this added heat filter, the volume of light is not decreased to the point of affecting the clarity of the projected image. It is the opinion of many observers that the resulting blue-tinged image on the screen is more satisfactory from the standpoint of clarity of detail than the image from the pure white light.

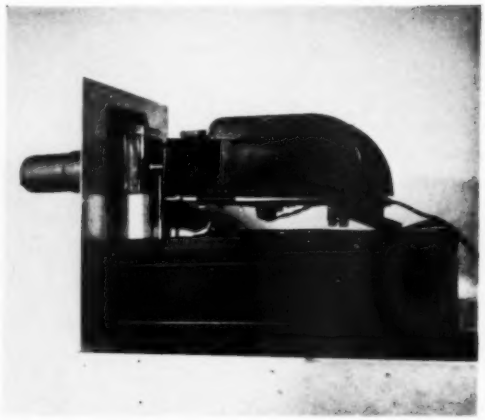

Fig. 3. Projection lantern for roentgenograms showing the use of a bellows type lantern as a source of light and a laboratory jar of blue copper sulfate solution between light source and roentgenogram as a heat filter. The carrying case is employed as a means for elevating the lantern, and the aluminum plate is fixed to the table.

There is also less accompanying eye strain if the projected image is viewed for any length of time. If two pieces of heat-absorbent glass are used, they may be either circular or rectangular in shape. For circular filters, 4 1/2 in. diameter is a convenient size and they may be placed in a special attachment as shown in Figure 1 for the type of lantern illustrated. If the glass is rectangular in shape, 4 3/4 × 5 in. is a convenient size. The rectangular filters may be used in the bellows type of lantern instead of the jar of copper sulfate solution as shown in Figure 3. These are placed in the position of the slide carrier, between the light source and the bellows. With this added heat filter, any type of black and white or color slide can be projected on to the screen and left for long periods without fear of damage.

The detail of the enlarged roentgenographic image on the screen is found to be excellent, provided the original roentgenogram is satisfactory. It is possible to project onto the screen clear images, with the use of different focal length projection lenses, at distances of from 5 to 150 feet, thus enabling sections of roentgenograms to be projected in a room or a large auditorium. The size of the image is de-

Fig. 4. Projection lantern for roentgenograms being used in an auditorium at 40 feet distance from the screen.

pendent on the focal length of the projection lens and the distance of the screen from the lantern. The type of lens found most useful for the lantern shown in Figure 1 is a 9-in. E. R. anastigmat coated lens. A lens of shorter focal length will give a larger image if desired. If the roentgenogram is moved around on the plate in front of the light source, a careful examination can be made of all portions of the film. This type of examination can be compared to the high-power examination of a slide with a microscope. Two large rubber bands around the plate, as in Figure 2, will adequately fix the roentgenogram to the plate if this is desired.

The enlarged projected image has been most satisfactory in clearly portraying details of pathology in such bone conditions as coxa plana, slipping of the upper femoral epiphysis, fractures, tuberculosis, osteomyelitis, tumors, localized bone changes, and arthritis. Minimal bone changes are more readily noted in the large projected image than in the film on a view box. It is the belief of the authors that 75 per cent of the pathologic changes in the roentgenograms used in orthopedic surgery are contained in a 3 × 4-in. area of the film to be examined. This method undoubtedly has a place, also, in spot projections of chest films and films of other parts of the body. There are many possibilities for the use of this projecting apparatus which the authors have not explored.

SUMMARY

1. A simple inexpensive method of projecting sections of a roentgenogram directly

onto a screen is outlined. This frequently obviates the necessity of lantern slides.

2. The apparatus can be assembled by utilizing existing projection equipment with the addition of a fenestrated plate and a heat filter in the form of a jar of copper sulfate solution or two pieces of 1/4-in. heat-absorbent glass, provided that the projection lens can be removed from the lantern and attached to the plate. If not, the added equipment necessary is a new projection lens and tube which can be attached to the plate.

3. The resulting projected image is large, clear, and detailed. It is especially desirable for teaching and lecturing, as well as for more detailed examination of the roentgenogram. It is possible to examine an enlarged projection of all sections of a roentgenogram, thus obtaining an examination similar to the study of a microscopic slide with high-power magnification.

4. The same apparatus may suffice to project large and small lantern slides with or without glass, without fear of burning or cracking the slides.

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SUMARIO

Sencilla Técnica para la Proyección Directa de una Sección de Radiografía en la Pantalla

El método bosquejado para proyectar partes de un roentgenograma directamente en la pantalla es sencillo y poco costoso.

El aparato necesario puede construirse utilizando accesorios de proyección ya a mano, agregándoles una placa fenestrada y un termofiltro compuesto de un tarro de solución de sulfato de cobre o de dos trozos de vidrio termoabsorbente de 6 mm. de grueso, con tal que se retire la lente de proyección de la linterna y se una a la placa. De otro modo, los nuevos accesorios necesarios comprenden una lente y un tubo de proyección que puedan conectarse con la placa.

La imagen proyectada es grande, clara y detallada, resultando en particular conveniente para clases y conferencias, así como para examen más detenido de la radiografía. Es posible así examinar una proyección agrandada de todas las secciones de una radiografía, lográndose un examen semejante al estudio de una película microscópica con aumento poderoso.

EDITORIAL

Smoking and Bronchogenic Carcinoma

Bronchogenic carcinoma as a cause of death has shown a progressive increase during the past several decades. Many theories have been advanced to account for this remarkable change in the vital statistics. Prolongation of the life span must be accorded some consideration, although the incidence of bronchogenic carcinoma has risen relatively more than that of cancer as a whole. The inhalation of gas engine exhaust fumes has been blamed by some, and occupational hazards may play a role. A number of recent studies have indicted tobacco smoking as a possible etiologic factor, and statistical studies strongly support this theory.

Wynder and Graham have made a study of 684 cases of proved bronchogenic carcinoma. In 605 of these (in men) they found that over 50 per cent of the patients were excessive or chain smokers compared to 19 per cent of a general hospital group without cancer. Only 2 per cent of the lesions occurred in non-smokers or minimal smokers. In 96 per cent of the carcinoma series there was a history of smoking for over twenty years, which may account for the greater incidence of the disease in men, as excessive smoking by women is of relatively recent development. Wynder and Graham believe that there may be a lag period of ten years or more, even after cessation of smoking, before the development of the neoplasm. A very high percentage (94.1 per cent) of the patients smoked cigarettes, and it is believed that the practice of inhalation among cigarette smokers may be of significance.

In a similar study, Doll and Hill reported their observations in 709 cases of carcinoma of the lung from twenty London hospitals. Of the men in this series 0.3 per cent and of the women 31.7 per cent were non-smokers. Among control non-cancer groups, the figure for men was 4.2 per cent and for women 53.3 per cent. Of the smokers with carcinoma of the lung, a high proportion were in the "heavy smoking" category; 26 per cent of the male patients and 14.6 per cent of the female carcinoma patients smoked the equivalent of 25 cigarettes per day, while only 13.5 per cent of the male and none of the female non-cancer control patients smoked as much. Cigarette smoking was found to be more closely related to carcinoma of the lung than pipe smoking.

Levin, Goldstein, and Gerhardt studied the smoking habits of patients with cancer involving both the lung and lip. Their data indicate that cancer of the lung occurs more than twice as frequently among those who have smoked cigarettes for twenty-five years than among non-smokers of comparable age.

The offending agent is not indicated from any of these studies, as distillates from tobacco have never been proved to be carcinogenic. Doll and Hill suggest that some other agent, such as spray material on tobacco plants, may be responsible.

The foregoing observations offer statistical evidence that there may be more than a casual relationship between long-continued heavy smoking, especially of cigarettes, and the occurrence of bronchogenic carcinoma. The roentgenologist is in a position to contribute further to the clarification of the situation. To this end, he should conduct his own investigation on all bronchogenic carcinomas coming under his care, reporting his findings to a central agency so that eventually the truth about this important problem may be known.

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Recommendations of the International Commission on Radiological Units (London, 1950)

SECTION A. UNITS

1. For the correlation of the dose of any ionizing radiation with its biological or related effects the International Commission on Radiological Units (I.C.R.U.) recommends that the dose be expressed in terms of the quantity of energy absorbed per unit mass (ergs per gram) of irradiated material at the place of interest.

In the foregoing paragraph by "energy absorbed" is meant the energy imparted to the material by ionizing particles at the place of interest.

2. Inasmuch as calorimetric methods are not usually practicable, ionization methods are generally employed. For this purpose the quantity which must be measured is the ionization produced in a gas by the same flow of corpuscular radiation as exists in the material under consideration. The energy, E_m, imparted to unit mass of the material, is then essentially related to the ionization per unit mass of gas, J_m, by the equation:

$$E_m = W_s J_m$$

where W is the average energy expended by the ionizing particles per ion pair formed in the gas, and s is the ratio of the mass stopping power of the material to that of the gas.

3. Since the calculation of the dose in absolute energy units from measurements of ionization requires a knowledge of the parameters W and s as well as variables characterizing the radiation and the irradiated material, the I.C.R.U. is of the opinion that tables of the best available data should be prepared as soon as possible and held under continual revision.

4. The Commission considers that the roentgen (designated by the symbol r), in view of its long established usefulness, should continue to be recognized as the unit of x- and gamma ray quantity or dose and that its definition remain unchanged.

The roentgen shall be the quantity of x- or gamma-radiation such that the associated corpuscular emission per 0.001293 gram of air produces, in air, ions carrying 1 electrostatic unit of quantity of electricity of either sign. (See Appendix, Note 1.)

5. It becomes increasingly difficult to measure the dose in roentgens as the quantum energy of the x-radiation approaches very high values. The unit may, however, be used for most practical purposes for quantum energies up to 3 Mev.

6. The I.C.R.U. does not recognize the use of special names or symbols for quantities which are merely multiples of the fundamental unit. (This does not preclude the use of generally used prefixes such as kilo-, milli-, etc.).

7. The I.C.R.U. recommends that the curie be used for the measurement of radioactive materials and that the definition be as follows:

"The curie is a unit of radioactivity defined as the quantity of any radioactive nuclide in which the number of disintegrations per second is 3.700×10^{10}."

This definition is in accordance with the definition of the curie adopted by the Commission on Standards, Units, and Constants of Radioactivity appointed by the International Council of Scientific Unions.

The Commission notes that when the curie is defined in this way the only point of revision which could arise would be the number of curies in 1 gram of radium. It is very improbable that this number would differ from unity by an amount of clinical significance although the distinction would clearly have to be taken into account in accurate radium standardization.

8. It is suggested that the gamma-ray emission be expressed in terms of r/mc. hr. at 1 cm. from a point source. As this quantity is different for every isotope the Commission will undertake the compilation of data relating to the gamma-ray emission of radioactive isotopes.

9. The I.C.R.U. requests the national standardizing laboratories to set up, interchange and compare standards of x-rays, gamma-rays, and radioactive isotopes, maintain close contact with each other, and generally by every means within their power further the improvement of methods of standardization.

SECTION B: DOSE OR THE SPECIFICATION OF THE CONDITIONS OF X-RAY TREATMENT

After discussion, the I.C.R.U. agreed to postpone the revision of Section B, which remains as follows:

10. In the description of the conditions of x-ray treatments, distinction shall be made between the quantity of radiation measured in air and the quantity of radiation estimated to have been received by the tissue. Since the symbol r is reserved for the unit, the amount of the dose may be designated by the letter D. The use of subscripts is suggested to

distinguish dosage measurement made under different conditions; *e.g.*, in free air—D; at the surface of the skin (including back-scatter)—D_0, etc. (See Appendix, Note 2.)

11. The specifications of treatment conditions shall include the following:

I. *Quantity.* The quantity of radiation (expressed in roentgens) estimated to have been received by the lesion.

II. *Quality.* (*a*) The spectral energy distribution of x-radiation shall be designated by some suitable index, called quality. For most medical purposes it is sufficient to express the quality of the x-radiation by the half-value layer in a suitable material: Up to 20 kv. (peak) cellophane or cellone; 20–120 kv. (peak) aluminum; 120–400 kv. (peak) copper; 400 kv. up (peak) tin. For a more definite specification of the quality of the radiation the complete absorption curve in the same material is preferable.

(*b*) Material and thickness of filter, including tube walls.

(*c*) Target material.

III *Technic.* (*a*) Total quantity of radiation per field (incident and emergent) received in an entire course of treatment.

(*b*) Quantity of radiation per field measured at the surface (D_0) at each individual irradiation.

(*c*) The dosage-rate expressed in r/min. during each individual irradiation.

(*d*) The total time over which a course of treatments is spread.

(*e*) The time interval between successive doses.

(*f*) The target-skin distance.

(*g*) The number, dimensions, and location of the ports of entry.

SECTION C: DOSE OR THE SPECIFICATION OF THE CONDITIONS OF GAMMA-RAY TREATMENTS

12. The specification of the conditions of gamma-ray treatments should, where possible, include statements of:

I. *Quantity.* The total quantity of radiation (expressed in roentgens) estimated to have been received by the lesion.

II. *Particulars of Radioactive Source.* (*a*) The total amount and nature of radioactive substance employed (expressed as equivalent mgm. of radium element).

(*b*) Type, number, and distribution of the containers.

(*c*) The material and thickness of filters and the nature of the material externally adjacent to the skin.

III. *Technic.* (*a*) In the case of surface applicators or "large radium units," the quantity of radiation per field at the surface.

(*b*) The dosage-rate during each individual irradiation.

(*c*) The total time over which a course of treatments is spread.

(*d*) The time intervals between successive irradiations.

(*e*) In the case of surface applicators or "large radium units," the radium-skin distance.

(*f*) The number, dimensions, and situations of the ports of entry.

SECTION D: INSTRUMENTS

13. The following types of apparatus are suggested as suitable for the measurement of quantity in roentgens:

(*a*) *X-Ray Primary Standards.* The free air chamber shall be used for free air measurements for all wave lengths down to the practical limit set by the consideration that the chamber must be of such width and length that the full ionization produced by the corpuscular emission from air is measured in accordance with the definition (A, 4). An air-wall chamber which meets the requirements of the definition may be used for harder radiations.

(*b*) *X-Ray Practical Instruments.* The air-wall chamber may be used for clinical measurements of x-ray quantity over the entire voltage range.

(*c*) *Gamma-Ray Standards and Practical Instruments.* The air-wall chamber may be used for the measurement of primary or scattered radiation or a combination of both.

14. Instruments used to measure radiation quantity or dosage may conveniently be called dosemeters and dosage-rate (or dose-rate) meters, respectively, and shall be calibrated in roentgens or roentgens per minute.

15. The calibration readings of dosemeters and dosage-rate meters should be independent of the wave length within the range for which they are designed or used.

16. Dosemeters and dosage-rate meters should be provided with suitable arrangements (*e.g.*, standard radium source, Bronson leak, or capacity sharing device) for checking the reproducibility of their readings.

17. The calibrations of dosemeters or dosage-rate meters should be tested periodically by a recognized testing laboratory over the range of wave lengths for which they are designed or used.

18. The national standardizing laboratories shall be invited to undertake standard measurement and the calibration of dosemeters relative to all forms of radiation therapy to which these recommendations may apply. They shall also be invited to issue joint reports from time to time thereon.

SECTION E: APPENDIX

Note 1. Note that 0.001293 gram is the mass of 1 c.c. of dry atmospheric air at 0° C. and 760 mm. of mercury pressure.

Note 2. For example, in an hypothetical case of medium x-rays: The dose measured in air, D, equals 300 r. The dose measured at the surface, D_0, equals 500 r. The dose measured at x cm. depth, D_x, equals 200 r.

(N.B. D is not to be confused with the energy actually absorbed by the tissue.)

SECTION F: RULES GOVERNING THE SELECTION AND WORK OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS

19. (*a*) The International Commission on Radiological Units (I.C.R.U.) shall be composed of not more than twelve (12) members. The selection shall be made by the International Executive Committee (I.E.C.) from a list of nominations submitted by the national delegations and by the I.C.R.U. itself. Members of the I.C.R.U. shall be chosen on the basis of their recognized activity in the field of radiological units and standards, without regard to nationality.

(*b*) The I.C.R.U. shall be composed of at least three medical radiologists and three physicists.

(c) The members of the I.C.R.U. shall be selected during one International Congress to serve through the succeeding Congress. Not less than two but not more than four members of the I.C.R.U. shall be changed at any one Congress. In the intervening period a vacancy caused by conditions beyond control of the I.E.C. shall be filled on the recommendation of the I.C.R.U.

(*d*) In the event of a member of the I.C.R.U. being unable to attend the I.C.R.U. meetings a substitute may be selected by the I.C.R.U. as a temporary replacement. Such a substitute member shall not have voting privileges at the meetings unless specifically authorized by the I.E.C.

(*e*) The I.C.R.U. shall be permitted to invite individuals to attend its meetings to give special technical advice. Such persons shall not have voting privileges, but may ask permission to have their opinions recorded in the minutes.

20. The continuance of the policies and records of the I.C.R.U. shall be in the hands of a Secretary of the I.C.R.U. elected by the I.C.R.U. from among its regular members and subject to the approval of the I.E.C.

21. The I.C.R.U. shall familiarize itself with progress in the whole field of radiation units and standards. The Secretary shall be responsible for the preparation of a program to be submitted to the Committee for discussion at its meetings. Preliminary reports shall be prepared and circularized to all members of the I.C.R.U. and other specially qualified individuals at least six months before the meeting of the Congress.

22. The Chairman shall be elected by the I.C.R.U. at least six months in advance of the Congress. The choice shall not be limited to the members of the I.C.R.U. or to the country in which the Congress is held. Such a chairman shall be a member of the I.C.R.U., *ex officio*, but for the period of the Congress only. Meetings between Congresses shall be presided over by the Secretary or other member selected by the I.C.R.U.

23. Decisions of the I.C.R.U. shall be decided by a majority vote, with the Chairman casting the deciding vote in case of a tie. A minority opinion may be appended to the minutes of a meeting if so desired by any member and upon his submission of same in writing to the Secretary.

W. V. MAYNEORD, *Chairman*, Great Britain
L. S. TAYLOR, *Secretary*, U.S.A.

W. Binks, Great Britain
R. Coliez, France
F. Ellis, Great Britain
G. Failla, U.S.A.
H. Holthusen, Germany
G. C. Laurence, Canada
R. R. Newell, U.S.A.
W. J. Oosterkamp, Holland
B. Rajewsky, Germany
R. Sievert, Sweden
A. Tivoli, Italy

ANNOUNCEMENTS AND BOOK REVIEWS

EASTERN CONFERENCE OF RADIOLOGISTS

The Eastern Conference of Radiologists will be held March 8–10, 1951, at the Lord Baltimore Hotel, Baltimore, Md. The scientific program will be presented by the Johns Hopkins Hospital and the University of Maryland Hospital. A well planned ladies' program has also been arranged. Inquiries should be directed to J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2, Md.

GREATER CINCINNATI RADIOLOGICAL SOCIETY

The newly elected officers of the Greater Cincinnati Radiological Society are: Dr. Norman Adair, President; Dr. Archie Fine, Vice-President; Dr. Lawrence Gibboney, Carew Tower Bldg., Cincinnati, Secretary-Treasurer.

KENTUCKY RADIOLOGICAL SOCIETY

At a recent meeting of the Louisville Radiological Society, it was unanimously voted to change the name of the organization to the Kentucky Radiological Society. The newly chosen officers are Dr. John Dixon, Owensboro, President; Dr. E. Lee Shiflett, Louisville, Vice-President; Dr. E. L. Pirkey, 323 East Chestnut St., Louisville, Secretary-Treasurer. The Society will continue to meet on the second Friday of each month at 6:30 P.M., at the Seelbach Hotel.

NORTH CAROLINA RADIOLOGICAL SOCIETY

At the November meeting of the North Carolina Radiological Society, Dr. J. T. Marr of Winston-Salem became President; Dr. J. Donald McRae of Asheville was elected Vice-President; Dr. Allen Tuggle of Charlotte, President-Elect; Dr. James E. Hemphill of Charlotte, Secretary-Treasurer. Other members of the Executive Committee are Dr. Westbrook Murphy of Asheville, Dr. Graham Barefoot of Wilmington, Dr. Robert Reeves of Durham, and Dr. T. D. McRae of Asheville.

TEACHERS OF CLINICAL RADIOLOGY

The Eighteenth Annual Conference of Teachers of Clinical Radiology will be held at the Palmer House in Chicago, Ill, on Feb. 10, 1951. All radiologists are invited to attend.

The subject of the 1951 Conference, "Radiologic Defense," is currently of extreme importance. The radiological aspects of civil defense in the event of atomic attack are the legitimate concern of every radiologist, and every radiologist has an obligation to be informed on the subject.

The program of the Conference follows:

Morning Session: 9:00 A.M.–12:00 M.

Chairman, Dr. Robert R. Newell, Chairman Commission on Radiological Units, Standards, and Protection

Mobilization of Health Resources for Defense: Dr. Norvin C. Kiefer, Director Health Resources Office, National Security Resources Board.

The Duties of Physicians in an Atomic Disaster: Brig. Gen. James P. Cooney, M.C., USA, Chief, Radiological Branch Military Application Division, Atomic Energy Commission.

Atomic Bomb Effects—Teaching Aids from Armed Forces Institute of Pathology: Dr. Elbert De Coursey, Director, Armed Forces Institute of Pathology.

Luncheon: 12:15

Grand Ballroom, $3.40 per plate

Address by C. Edgar Virden, M.D., President, American College of Radiology.

Afternoon Session: 2:00–4:30 P.M.

Chairman, Dr. John D. Camp, Chairman Commission on Education

The Diagnosis and Treatment of Radiation Injuries. Comdr. Eugene Cronkite, USN, M.C., Naval Medical Research Institute.

Training for the Detection of Radiation Hazards—Instruments — Personnel: Dr. William Bale, Biophysics Branch Division of Biology and Medicine, Atomic Energy Commission.

Radioactive Decontamination: Dr. Claude R. Schwob, Chief of Chemistry Branch, U. S. Naval Radiological Defense Laboratory.

The Conference is being sponsored by the Commission on Education and the Commission on Radiological Units, Standards and Protection, of the American College of Radiology. Reservation forms will be distributed with the December issue of the Monthly *News Letter* of the College, or may be obtained by writing the American College of Radiology, 20 North Wacker Drive, Chicago 6, Ill.

FELLOWSHIP IN PEDIATRIC ROENTGENOLOGY

Applications are being accepted for the Fellowship in Pediatric Roentgenology in the Children's Hospital of Cincinnati. The Fellowship is administered by the Department of Roentgenology of the University of Cincinnati for work and study in the Department of Roentgenology in the Children's Hospital.

Two years prior training in Radiology in an approved institution is required. The Fellowship runs for a period of one year beginning July 1, 1951. For further particulars, communications should be addressed to Dr. Frederic N. Silverman, Director, Department of Roentgenology, Children's Hospital, Cincinnati 29, Ohio.

RADIOISOTOPES COURSE

A special two-weeks advanced medical course in radioisotope work will be given by the Oak Ridge Institute of Nuclear Studies beginning on Feb. 5, 1951. The course, dealing with radioisotopes in therapy and in clinical studies, is intended for research workers in the field of medicine who have had some experience in the basic technics of using radioisotopes.

The first week will be devoted to lectures and laboratory work on radioisotopes in therapy. Subjects covered during this period will include clinical autoradiography, phosphorus 32, radium implantation, colloidal gold and other isotopes, and iodine 131, along with the interaction of radiation with matter, radiation safety, radiation laboratory design, radiation administration in a hospital, dosimetry, and effects of radiation on blood.

The second week will be concerned with radioisotopes in clinical tracer studies. Subjects covered during this period will include the diagnostic technics of brain tumor localization and thyroid metabolism studies, water balance studies, cardiovascular research and blood volume, iron metabolism studies, radiation genetics, steroid studies, phospholipid studies, advances in medical instrumentation, protein metabolism studies, other non-mineral metabolism studies, mineral metabolism studies in experimental animals, and mineral metabolism studies in man.

A limited number of applicants who are able to attend for only one week can be accommodated. A fee of $25.00 will be charged for the course.

Application forms are available from Dr. Ralph T. Overman, Chairman of the Special Training Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE PREPARATION OF PHOTOGRAPHIC PRINTS FOR MEDICAL PUBLICATION. By STANLEY J. McCOMB, F.B.P.A., Section on Photography, Mayo Clinic, Rochester, Minn. Publication No. 90, American Lecture Series, edited by Ralph P. Creer, F.B.P.A. A volume of 69 pages, with 21 figures. Published by Charles C Thomas, Springfield, Ill., 1950. Price $2.00.

Book Reviews

PEDIATRIC X-RAY DIAGNOSIS. A TEXTBOOK FOR STUDENTS AND PRACTITIONERS OF PEDIATRICS, SURGERY AND RADIOLOGY. By JOHN CAFFEY, A.B., M.D., Professor of Clinical Pediatrics, College of Physicians and Surgeons, Columbia University; Attending Pediatrician and Roentgenologist, Babies Hospital and Vanderbilt Clinic, New York City; Consulting Pediatrician, Grasslands Hospital, Westchester County, N. Y., and New Rochelle Hospital, N. Y.; Consulting Roentgenologist, Orange Memorial Hospital, Orange, N. J.; Consultant in Pediatric Roentgenology, The New York Hospital, New York City. A volume of 862 pages, with 1,039 illustrations. Published by the Year Book Publishers, Inc., Chicago, Ill., 2d edition, 1950. Price $22.50.

Doctor Caffey's popular work on Pediatric X-Ray Diagnosis has been greatly improved in this second edition, not only by the addition of new text and illustrations but by a new format as well. The use of two columns and smaller type permits the inclusion of more material and has been shown to make for easier reading. The presentation is in six general sections as in the first edition. A number of new subjects have been added and others have been expanded or entirely rewritten.

One of the valuable features of this text is the emphasis laid on the normal roentgen appearance and slight variations from the normal in contrast to those produced by disease and developmental deformities. The descriptions are brief and lucid with adequate illustrations in most instances. Short bibliographies of source material are scattered throughout the work, following immediately after the discussions of the various lesions described.

In reading this text, one cannot but be impressed by the wide experience and sound judgment of the author. His book stands alone in its field and is an essential for the library of the diagnostic radiologist.

THE ESOPHAGUS AND PHARYNX IN ACTION. A STUDY OF STRUCTURE IN RELATION TO FUNCTION. By WILLIAM LERCHE, M.D., Fellow, American College of Surgeons; Founder Member and Honorary Member of the American Association for Thoracic Surgery; Formerly, Associate Professor of Surgery, University of Minnesota, Minneapolis, Minn. A volume of 230 pages, with 105 illustrations. Published by Charles C Thomas, Springfield, Ill., 1950. Price $5.50.

The author's main emphasis in this anatomic and physiologic study of the esophagus and pharynx is

on the closing mechanism at the cardia. Most of his studies were made from anatomical specimens, several of which showed persisting local areas of contraction associated with regurgitation.

The anatomy of the esophagus is discussed and related to the physiology of swallowing. Consideration is also given to variations from the normal physiology and their relation to abnormal anatomy and disease processes. The text is well illustrated by photographs of anatomical specimens and drawings from roentgenograms. Radiologists, however, would have been better pleased with reproductions of the original films.

Space limitations preclude a detailed description of the contents of this work. Roentgenologists and clinicians dealing with gastro-intestinal problems will find it stimulating as well as informative. A valuable bibliography is appended. An adequate subject index is also added.

LEHRBUCH DER RÖNTGENDIAGNOSTIK. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, E. UEHLINGER, with contributions by E. BRANDENBERGER, A. BRUNNER, U. COCCHI, N. P. G. EDLING, J. EGGERT, F. K. FISCHER, M. HOLZMANN, H. RAYENBÜHL, Å. LINDBOM, E. LINDGREN, G. A. PREISS, S. WELIN, AND A. ZUPPINGER, Vol. I. The Skeletal System. Part I. A volume of 426 pages, with 507 illustrations. Part II. A volume of 452 pages, with 764 illustrations. Published by Georg Thieme, Stuttgart, 5th completely revised edition, 1950. Sole distributors for the U.S.A. and Canada: Grune & Stratton, Inc., 381 Fourth Ave., New York 16, N. Y.

An adequate review of a work of this caliber would entail listing both the topics discussed and the high points of the component sections. This is impossible in any limited space because the range of discussion is from the most commonplace to the most rare. A surprising quantity of material creates a true compendium of diagnostic radiology. For example, the section in Part I on normal ossification utilizes seventy-eight illustrations and tables along with twenty-seven pages of text. In Part II may be found three pages of text accompanying a beautiful set of x-ray reproductions on "Camurati-Engelmann's Disease," recently described by H. R. Sear as "the rarest of all bone diseases."

The opening statement of Part I integrates scientific roentgenology with the general art of healing and particularly with first causes, clinical observation, and prognosis. More than half of Part I relates directly to first principles, with discussions of the theory and nature of x-rays, machine circuits, geometry of the roentgen image, fluoroscopy, stereoscopy, parallax, and contrast, detail, definition, and summation shadows of the roentgen image. A section on protection seems a trifle brief, considering that it is followed by twenty-three pages on x-ray crystal analysis.

Diagnostic roentgenology of the skeletal system occupies the remainder of Part I and all of Part II, with logical sequence and continuous pagination in the two parts. Roentgenology of the normal skeleton, general changes associated with bone pathology, circulatory disturbances of bone, bone injury from heat, cold, and electric shock appear in that order. A major work in itself is the discussion on fractures, with line drawings which are significantly practical in clarifying both usual and unusual fracture variants.

Part II opens with a consideration of the aseptic necroses. Here completeness is emphasized, with an illustration provided for each of the numerous localizations of the process. A chapter on toxic bone changes, as from heavy metals, is followed by one dealing with inflammatory bone disease: acute osteomyelitis, tuberculosis, mycotic infections, and others, through to glanders. The lover of the obscure will have a field day in U. Cocchi's section on hereditary disturbances with bone changes. Two hundred pages are devoted to such ailments as Albers-Schönberg disease, familial osteolysis, melorheostosis, phocomelia. While these diseases individually may be rare, in the aggregate instances may be seen daily. The frequent use of animal analogy (such as the occurrence of osteopetrosis in dugongs) may provide the interest to fix the disease in the mind's eye. The introductory paragraphs for primary bone tumors mark the close of Part II.

The work as submitted for review was inadequately bound in paper. Presumably the books will be available in cloth. Unfortunately the roentgen reproductions reverse the better practice of showing negatives. Detail, clarity, and applicability are nevertheless good. It should be noted that the term "Part" (Lieferung) applies to each separate book and is the press-run unit by which the book is sold.

Should the coming volumes fulfill the promise of these first two, this text will be a *sine qua non* of the study of roentgenology. Fortunately for those who do not read German easily, an English translation of this work is in preparation under the direction of Dr. James T. Case. Its publication is scheduled for the first half of 1951.

GASTRITIS, ULKUS UND KARZINOM. RÖNTGENSTUDIE UNTER BERÜCKSICHTIGUNG FORMAL-GENETISCHER BEZIEHUNGEN. By PROF. DR. J. BÜCKER, Chefarzt der Röntgen-Abteilung des Allgemeinen Krankenhauses, Heidberg, Hamburg. A monograph of 90 pages, with 82 illustrations. Published by Georg Thieme, Stuttgart, 1950. Agents for United States: Grune & Stratton, Inc., New York.

The differential diagnosis of gastritis, gastric ulcer, and gastric carcinoma has achieved very great advances in late years. The modern development of fluoroscopically directed roentgenography permits

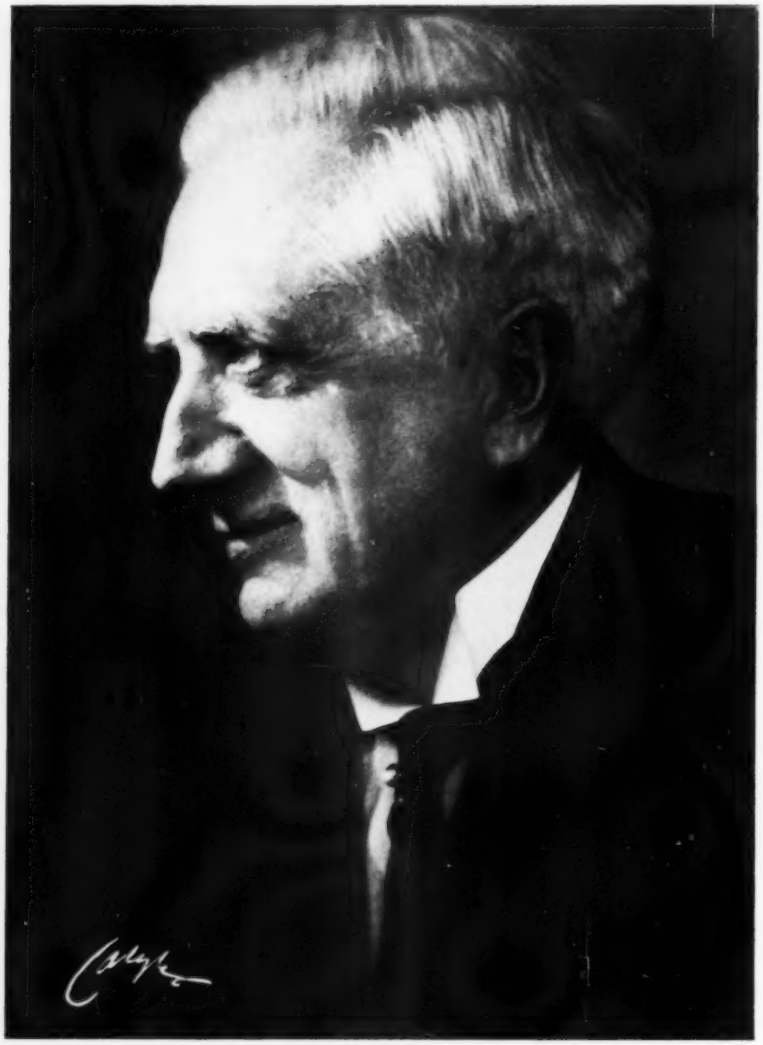
recognition of even very small changes in form. Furthermore, the conception of these three great morbid manifestations of the stomach has been greatly simplified.

Replacing the study of relatively gross pathologic changes, progress in the knowledge of functional and morphologic interpretation of mucosal patterns has brought about great improvement in diagnosis. The most important advance has been in the study of delicate mucosal patterns. Gastritis is characterized by a patchy hyperplastic granular form of mucosal pattern, not yet to any extent mentioned in the literature.

The roentgen manifestations of gastric ulcer were placed upon a firm basis by the work of Haudek nearly four decades ago. The demonstration of alteration of the gastric mucosa in the region of the niche is of such significance that there is now greater possibility of solving the problems of penetration, threatening perforation, the age of the ulcer and its prognosis, all of which demand a critical evaluation of the ulcer border and of the immediate environs with reference to acute or chronic inflammatory changes.

In cancer of the stomach the aim is to establish an early diagnosis, hence the importance of the study of the mucosa. The patchy hyperplastic form of gastritis may present extraordinary resemblance to the early changes of carcinoma. The author discusses the significance and importance of gastritis in the sense of the conception of Konjetzny with regard to the development of gastric malignant disease.

Emphasis is placed upon the role of the roentgenologist in this differentiation, especially in the interpretation of the part played by gastritis. In ulcer of the stomach the radiologist no longer sees a simple niche but so-called gastritis patterns which accompany the ulcer, the presence of which alters the prognosis. The author insists upon the unity of the three disease processes and believes there is an etiologic interrelationship.



PROFESSOR GÖSTA FORSSELL

1876–1950

Professor Gösta Forssell, who was one of the world's leading radiologists, died Nov. 13, 1950, at the Caroline Hospital, Stockholm, Sweden. He was born in 1876.

Professor Forssell was recognized throughout the world as one of the pioneers in radiology. He was included among the five pioneers by Professor Schinz and his colleagues of Zurich, Switzerland, in the dedication of their great diagnostic work published in 1928. He was well versed in physiology and anatomy, as well as a leader in research in diagnostic and therapeutic radiology.

Professor Forssell organized and edited *Acta Radiologica* from its beginning until the time of his death. This publication, which has reached its thirty-third volume, together with 77 Supplements

(monographs) upon special subjects, has furnished most valuable contributions to the science and practice of radiology.

As Chief of the X-ray Department of the Seraphim Hospital in Stockholm from 1906 to 1940, and Professor of Roentgen Diagnosis at the Royal Caroline Hospital and Institute from 1917 to 1941, Dr. Forssell made many contributions to the study and treatment of cancer, but he is remembered chiefly as the great leader in the development and management of the Radiumhemmet. Many American radiologists have had the privilege of visiting him and seeing the results of his work and leadership in these great institutions. They not only obtained information but much inspiration and encouragement in the difficult problems of cancer research. He had associated with him great leaders, of whom Heyman and Berven are best known in the United States.

In 1928, Professor Forssell served as President of the Second International Congress of Radiology, which in the minds of those of us who had the privilege of attendance, will always stand out as an ideal for International Congresses in the general manner in which it was conducted, its dignity, organization, and entertainment. The present writer had the privilege of serving with him on the Executive Committee of both the First and Second International Congresses of Radiology, and his wisdom and leadership were recognized by all.

In 1898, in connection with the King's 70th Anniversary, the King Gustav Fund for combating cancer was established, and Dr. Forssell drew up the directives for its use, thus giving radiological cancer treatment in Sweden an organization which is considered unique in the world. It is the only organization to my knowledge in which 100 per cent "follow-up" is obtained.

Dr. Forssell was an Honorary Member of the Radiological Society of North America, which made him the recipient of its gold medal in 1922. He was a member, also, of the American Roentgen Ray Society, the American Radium Society, and the American College of Radiology, as well as of the radiological societies of other countries. He received honorary degrees from Upsala, Copenhagen, Oslo, Kiel, Hamburg, Zurich, and Washington Universities. In 1938, on King Gustav's 80th Anniversary, Dr. Forssell was the nation's spokesman at a festival in the Stockholm Stadium.

Professor Forssell was not only one of our greatest pioneers and leaders in the science and practice of radiology and an inspiration to all radiologists; he was a dignified and charming personal friend to those who had the privilege of knowing him.

GEORGE E. PFAHLER, M.D.

HENRY JOHNSON ULLMANN, M.D.

1881–1950

Henry J. Ullmann, born in Evanston, Ill., Dec. 16, 1881, was killed in a plane crash on Oct. 15, 1950. He was returning from an inland lake accompanied by his son and daughter-in-law and their pilot. The local airport was fog covered and in attempting an instrument landing the plane crashed in the channel off the Santa Barbara coast.

Dr. Ullmann was graduated from Rush Medical College in June 1912. He was in active military service in 1917–19, attached to the 22d Casualty Clearing Station of the AEF. He was discharged with the rank of Major in 1919 and was a Lieutenant-Colonel in the Army Medical Reserve. He served as Radiologist in St. Joseph's Hospital and the Children's Hospital in Chicago in 1920 and 1921. In 1921 he went to California, where he was Radiologist to the Santa Barbara Cottage Hospital from 1921 to 1926. After 1926 he was Radiation Therapist and the Director of the California Society of Cancer Research for the Cottage Hospital.

In 1950, due to Dr. Ullmann's interest and activities in cancer problems and to the generosity of Elisha Converse, the Memorial Research Foundation was organized. This provided an addition to the radiation therapy wing of the Santa Barbara Cottage Hospital and installation of a one-million-volt therapy unit.

Dr. Ullmann was a member of the American Roentgen Ray Society, the Radiological Society of North America, the American Radium Society, of which he was president in 1930–31, and the American Medical Association. He was a Fellow of the American College of Physicians and a Diplomate of the American Board of Radiology. He was a member of the Cancer Commission of the California Medical Association and a Director of the California Division of the American Cancer Society. His numerous contributions to medical literature dealt chiefly with research and radiation therapy. His hobbies were pistol and rifle shooting.

In 1909, Dr. Ullmann married Helen Luscome, who died in 1918. In 1920 he married Helen Ingalls Graves. He is survived by his wife and a daughter by his first marriage, Helen Ullmann Leatherbee.

MILTON J. GEYMAN, M.D.

JOHN B. JACKSON, M.D.

1876–1950

Dr. John B. Jackson of Kalamazoo, Mich., died at Borgess Hospital in that city on Nov. 2, 1950, at the age of seventy-four.

Dr. Jackson was born on June 11, 1876, near Kalamazoo. He early attained the principles of the art of teaching, acting as superintendent of Lawton High School and serving as high school principal at St. Joseph, Michigan. He studied at the University of Michigan and the Rush Medical College, receiving his degree from the latter institution in 1903. His internship was at St. Mark's Hospital, Salt Lake City, Utah.

Dr. Jackson was for twenty-two years an associate of the late Dr. A. W. Crane of Kalamazoo, and following the latter's death, in 1937, continued a strenuous practice which culminated in 1939 in the formation of a group of radiologists in a building which he helped design, primarily for the practice of radiology. He held the position of Chief of Staff at Bronson Methodist Hospital for many years after its organization and he served the staff of Borgess Hospital from its beginning. In World War I, he served as medical advisor for the local military district of 35 counties. Though Providence caused him to suffer more than the average person, Dr. Jackson overcame the hardships of arthritis, duodenal ulcer, renal calculi, and cancer of the urinary bladder, maintaining an active practice

until just two years before a terminal cardiac episode. He was an exponent of the philosophy that hard work never hurt anyone.

Dr. Jackson was endowed with a remarkably keen mind. He was well grounded in Pediatrics and Internal Medicine before he entered the field of Radiology. His early versatility as a scholar and student of medicine is reflected by many publications in the twenties, on a range of subjects which included anesthesia, basal metabolism, medical legislation, Addison's disease and pyelography, as well as adult and childhood tuberculosis. He was a member of the Radiological Society of North America, the American Roentgen Ray Society, and the Trudeau Society, and a Fellow of the American Medical Association, the American College of Radiology, and the American College of Physicians. He was past-president of the Kalamazoo Academy of Medicine, and in 1926 was president of the Michigan State Medical Society.

This master physician and radiologist was beloved also as a religious leader, a civic leader, and as a brilliant personality. He was "as every man in life should wish to be." Burdened by remarkably heavy responsibilities, he nevertheless steadfastly kept faith, only to shower it upon others. His was the ability of understanding. His was the virtue of equanimity. His was the love that flowed out to all—and particularly to children. The people and the doctors of Kalamazoo feel a deep sense of loss in his passing.

R. C. HILDRETH, M.D.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., Baltimore, Md.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS. *Secretary*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M.D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, Clifford W. Wauters, 701 High St., Auburn. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Merrell A. Sisson, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meetings bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Thos. H. Lipscomb, M.D., 30 West Beaver St., Jacksonville, 2. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, David Kirsh, M.D., 712 duPont Bldg., Miami 32. Meets monthly, last Wednesday, 8:00 P.M.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ted F. Leigh, M.D., Emory University Hospital. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Willard C. Smullen, M.D., St. Mary's Hospital, Decatur.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY, *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB, *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meetings first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, H. R. Senturia, M.D., Pasteur Medical Bldg. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell W. Blanchard, M.D., 1216 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday at the Harvard Club.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Peter J. Gianquinto, M.D., 685 High St., Newark 2. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, John L. Olpp, M.D., 49 Ivy Lane, Tenafly, N. J.

QUEENS ROENTGEN RAY SOCIETY. *Secretary*, Jacob E. Goldstein, M.D., 88–29 163rd St., Jamaica 3. Meets fourth Monday of each month.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Vaughn Winchell, M.D., 40 Meigs St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 807 Broadway, Fargo.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., 10515 Carnegie Ave., Cleveland 6. Meetings at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Lawrence Gibboney, M.D., Carew Tower Bldg. Meets first Monday, September to May.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. Todd Jessell, M.D., 224 Medical-Dental Bldg., Portland 5. Meets monthly, on the second Wednesday, at 8:00 P.M., in the library of the University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, S. H. Fisher, M.D., 107 E. North St., Greenville. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets with State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, John E. Whiteleather, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON X-RAY CLUB. *Secretary*, Curtis H. Burge, M.D., 3020 San Jacinto, Houston 4. Meetings fourth Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. C. Kiltz, M.D., 705 Medical-Dental Bldg., Everett. Meetings fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee. Meets in May and with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute, Madison 6.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, Jean Bouchard, M.D. Associate Honorary Secretary-Treasurer, D. L. McRae, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 26, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPÍA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Cerebral Angiography in "Brain Tumor Suspects." George G. Culbreth, A. Earl Walker, and Robert W. Curry. J. Neurosurg. **7:** 127–138, March 1950.

The authors report the angiographic findings in a consecutive series of brain tumor suspects seen over a period of approximately one year.

In 93 of the 96 patients subjected to angiography, satisfactory angiograms were obtained. The diagnosis in 54 of these was verified by surgery or autopsy. In a group of 42 verified brain tumors the lesion was correctly localized by angiography in 39. In 8 cases the angiograms were indicative of a lesion, but for medical or personal reasons it was not verified. In 31 cases the angiograms were interpreted as normal, and in 24 of these in which air studies were made pneumoencephalograms did not suggest a space-occupying lesion. One of these patients whose angiogram was interpreted as normal had a thalamic tumor demonstrated by air study.

Angiograms may indicate the presence of a lesion by distortion of normal vascular structures or by showing the intrinsic vascular pattern of the tumor.

Angiomatous malformations and tumors are well demonstrated by angiography. Arteriovenous angioma is the most common type of malformation encountered. It shows enormous channels and sinuses fed by large tortuous arteries and drained by hugely dilated veins. The normal vessels supplying the cerebral hemisphere are rarely demonstrated.

Approximately two-thirds of the glioblastomas have increased vascularity at the margin of the tumor, with sinuses, irregular dilatations, and vascular loops within the tumor.

Astrocytomas show displacement of normal vessels by an avascular area or an area having a few fine, uniform, straight or slightly curved vessels.

The vascular pattern of meningiomas varies greatly. The specificity of the angiographic picture is more dependent upon the morphological structure of the lesion than its intrinsic vessels.

Fifteen roentgenograms; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California

Cerebral Angiography Recorded Cinefluorographically. Harvey Gass, Sydney Weinberg, Albert Craig, John J. Thompson, and Frank Dreisinger. J. Neurosurg. **7:** 139–145, March 1950.

A cinefluorographic unit has been used to record cerebral angiograms. It consists of a 35-mm. camera equipped with a f/0.85 lens and a du Pont-Patterson E-2 screen. The camera speed is 60 frames per second, which results in moderate slow motion on projection. The camera is operated synchronously with the 60-cycle alternating-current, and by resort to half-wave rectification the roentgen-ray impulses which ordinarily would occur during the shutter-closed phase of the camera are suppressed. Each exposure lasts 1/246 second. One hundred kilovolts and 150 ma. are constant factors for all exposures. The target-screen distance varies between 28 and 30 inches, resulting in a total dose of between 20 and 25 r over a period of three and a half to five seconds. The 35-mm. film is optically printed on 16-mm. film. This method requires only a single small injection, is much easier, more certain, and less traumatic than the conventional methods of angiography. However, the quality of the image lacks the sharpness and definition of still angiograms.

Thirty-nine angiograms; 1 photograph of the apparatus.

HOWARD L. STEINBACH, M.D.
University of California

Subdural Fluid as a Consequence of Pneumoencephalography. Honor V. Smith and Bronson Crothers. Pediatrics **5:** 375–389, March 1950.

In at least one-third of the children subjected to pneumoencephalographic studies, air enters the subdural space. This occurs much more frequently in children under two years of age than in older ones, and in children in whom the lateral ventricles are greatly dilated. Roentgenographically the air is seen lying over the cerebral hemispheres and dipping down beside the falx cerebri to outline the superior sagittal sinus. The smooth medial border of this air shadow and the consequent clear definition of the sinus is pathognomonic of subdural air and enables even small bubbles to be correctly localized. In some cases subsequent roentgenograms show that as the air has been absorbed a definite fluid level appears.

In approximately one-third of the cases in which air enters the subdural space, recovery from pneumoencephalography is delayed by the development of signs and symptoms suggesting a rise in intracranial pressure. The children are pale and drowsy and are irritable if aroused. Projectile vomiting frequently occurs. In such cases fluid that is characteristic of that found in subdural hematoma usually is present. It is suggested that as air enters the subdural space and the brain falls away from the dura, vessels may be torn as they cross this space to reach the superior longitudinal sinus, with the formation of a subdural hematoma.

Nineteen roentgenograms; 4 tables.

HOWARD L. STEINBACH, M.D.
University of California

Intraventricular Extension of an Aneurysm of the Anterior Cerebral Artery. Report of a Case With Successful Removal. Dean H. Echols and Homer D. Kirgis. Surgery **27:** 260–267, February 1950.

The authors review the literature on intracranial aneurysms, citing the observation of Cushing and others that these aneurysms rarely reach sufficient size prior to rupture to give symptomatic manifestations of their presence. They also point out that those aneurysms which do give "neighborhood" signs usually occur in the intradural portion of the internal carotid or basilar artery.

Failure to visualize certain types of aneurysm by intravascular injection of a radiopaque medium is probably fairly frequent. Pneumoencephalography or ventriculography may be a valuable supplementary method of examination in such instances, especially if the aneurysm is peripheral to the arterial circle. This is particularly true if, in addition to attacks of bleeding into the subarachnoid space, the patient presents a history and findings suggesting localized cerebral dysfunction.

A case is described which presented numerous features of interest. The aneurysm had undoubtedly been present, manifesting itself clinically by pressure on the brain, for at least two years. Although it arose from the proximal portion of the anterior cerebral artery, it had not involved cranial nerves or adjacent bone but had eroded the wall of the cerebral hemisphere and entered the lateral ventricle. When the wall of the aneurysm finally became defective, only a relatively small amount of blood escaped before the defect became occluded. However, repeated small quantities of blood probably escaped during the month between the first evident hemorrhage and removal of the aneurysm. Pneumoencephalography was well tolerated and adequately demonstrated the lesion.

Removal of the aneurysm by a transventricular approach was followed by complete freedom from headache and other signs of bleeding into the subarachnoid space, but evidence of some frontal lobe dysfunction persisted.

Three roentgenograms; 2 drawings.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Trigeminal Injection with Radiographic Control. Technic and Results. W. H. Sweet. J. A. M. A. **142:** 392–396. Feb. 11, 1950.

For a large group of patients with pain referable to the face, interruption of the nervous pathway from the painful area appears to be the best available therapy. Those persons with idiopathic trigeminal neuralgia or with malignant neoplasms of the face comprise the largest number of such patients, but, in addition, persons with more obscure forms of facial pain may with profit undergo diagnostic trigeminal injection.

The author has been using radiographic control for all trigeminal injections since 1940. Fifty-one of 54 attempts at injection have been successful.

For injection of the mandibular division of the fifth nerve, axial studies of the skull are made in order to localize the relationship of the needle point to the foramen ovale. Even if the point lies near the front or back of the foramen ovale, a successful injection into the entire nerve trunk has usually been attained by appropriate direction of the bevel of the needle without changing the position of the entire shaft of the needle.

For injection into the maxillary division, the foramen rotundum is demonstrated by postero-anterior studies of the skull made in a projection similar to the Waters sinus view. A series of roentgenograms are made until the needle point is in the proper position.

A detailed description of the technic for these injections is given.

Three roentgenograms; 1 drawing; 1 photograph.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Toxoplasmosis in a Nine-Year-Old Girl. Paul Freeman and Helen B. Pryor. J. Pediat. **36:** 365–369, March 1950.

A case of subacute toxoplasmosis in a 9-year-old girl is presented. The patient was normal at birth but her later development was retarded. She had gradual loss in vision of the right eye, due to an extensive chorioretinitis. There was some atrophy of the muscles of the left hand. Films of the skull revealed several small calcifications in the right cerebral cortex. A pyothorax developed in the left chest, which was thought to be the result of an infected congenital pulmonary cyst. Following excision of the cyst the patient died. A pathologic examination of the brain revealed areas of cortical degeneration with calcification, regional gliosis, and thickened leptomeninges.

Four roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

Aneurysm of the Internal Carotid Artery Simulating Tumor. Report of a Case. Jesse M. Levitt. Arch. Ophthal. **43:** 500–502, March 1950.

The case here reported illustrates the similarity of the clinical picture in aneurysm of the internal carotid artery and in basal neoplasm. The patient, a woman aged 50, gave a history of periodic pain in the right eye and frontal region of four years duration. She had generalized arteriosclerosis and an extremely high blood pressure of many years standing. Ocular examination revealed ophthalmoplegia and primary optic nerve atrophy of the right eye and hypesthesia of the right cornea. Roentgenograms of the skull showed erosion of the right optic canal and the adjacent border of the orbital plate, erosion of the right sphenoid ridge, and destruction of the dorsum sellae and posterior clinoid process. The preoperative diagnosis was meningioma of the right sphenoid ridge. Operation revealed a large aneurysm, probably arteriosclerotic in origin, of the intracranial portion of the internal carotid artery. The author states that arteriography in this case might have helped to establish the diagnosis before operation.

Four roentgenograms.

Roentgen Ray in the Diagnosis of Otolaryngologic Problems. Charles I. Johnson. Texas State J. Med. **46:** 97–103, February 1950.

The radiologist who correlates the roentgen findings in otolaryngologic conditions with the actual findings at operation will achieve a high degree of accuracy in diagnosis. Otolaryngologists are cautioned, however, against relying too heavily on the radiologist lest this dependence lead to an atrophy of clinical judgment through disuse.

Various rhino-otolaryngologic conditions in which roentgenologic investigation is utilized are briefly discussed. The value of the erect view in examination of the paranasal sinuses for the demonstration of fluid levels is emphasized. Tumors of the sinuses cause bony displacement or destruction and, owing to an increased blood supply, decalcification. New growths of the nasopharynx may also be demonstrated roentgenographically, but the author is opposed to relying wholly upon roentgen examination for the diagnosis of adenoid tissue or any abnormality in the soft tissue of this area, since a clinical examination can be made. Roentgen studies are of great value in demonstrating tumors of the sphenoid, chordomas, and other tumors that arise in the region of the sella turcica and invade the sphenoid and nasopharynx.

Roentgenographic examination of mastoids is valuable in demonstrating cholesteatomata and in giving the surgeon a radiographic outline of the anatomic relationships to serve as a guide during operative procedures.

Salivary calculi are frequently demonstrated by radiographic studies. Sialograms are often made to determine the patency of the salivary duct system.

The author does a routine lipiodol injection of the tear sacs prior to a Toti-Mosher operation, followed by roentgen studies to prove that the obstruction is in the nasolacrimal duct.

Ten roentgenograms.

JACK WIDRICH, M.D.
Cleveland City Hospital

Sarcoidosis (Boeck's Sarcoid) of the Upper Respiratory Tract. Report of a Case with Ten Years' Clinical Observation. David L. Poe and Paul S. Seager. Arch. Otolaryng. **51:** 414–419, March 1950.

A case of sarcoidosis of the upper respiratory tract is presented, with observations made over a ten-year period. Nodular lesions were present in the interior of the nose, the larynx, and trachea. Typical skin lesions were present on the face and hands. Roentgenologically a mass, which is not further described, was found in the mediastinum. There were decalcified areas in some bones of the fingers, toes, and mandible.

Two photomicrographs.

HOWARD L. STEINBACH, M.D.
University of California

THE CHEST

Bronchial Adenoma. Herman J. Moersch and John R. McDonald. J. A. M. A. **142:** 299–304, Feb. 4, 1950.

In the opinion of the authors, based on their experience with 86 cases, bronchial adenoma should be considered a carcinoma of low-grade malignancy capable of metastasizing. Two of the patients in their series had liver metastases (one was dead at the time of the report; the other in a failing condition). One patient had a metastasis in the upper lobe of the left lung from an adenoma in the lower lobe bronchus, and 2 others had involvement of the hilar lymph nodes.

Sixty-six of the authors' series, or 74 per cent, presented roentgenographic pulmonary changes of appreciable significance. In 20 cases roentgenograms of the thorax were non-informative. Tomography and bronchography were often found of great value in recognition of the lesion.

Pathologically there are 2 types of adenoma (both of which are supposed to originate in the mucous glands), the carcinoid and the cylindroma type.

In view of the cases which showed metastases and the 6 others which recurred after bronchoscopic removal, the authors believe that treatment should be more radical. Forty-five patients were treated primarily by lobectomy or pneumonectomy, and 6 others underwent operation following endoscopic treatment. Advanced age, the presence of infection in the obstructed lung, situation of the tumor too near the carina, and a very small lesion with a pedunculated attachment are indications for bronchoscopic removal and careful follow-up.

Four roentgenograms; 4 photomicrographs; 2 photographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Roentgen Diagnosis of Bronchial Adenoma. A. Méan. Acta radiol. **33:** 187–190, February 1950. (In German)

A case of bronchial adenoma diagnosed by bronchoscopy and tomography is reported. The author has reproduced the bronchogram and tomogram, with accompanying drawings.

Tuberculoma of the Lung Simulating Bronchogenic Carcinoma. Isidor Kross. Am. Rev. Tuberc. **61:** 431–435, March 1950.

An asymptomatic nodular lesion in the lung is reported. Clinical and roentgen diagnosis prior to surgery was bronchogenic carcinoma. The lesion proved to be a tuberculoma. The difficulty of making a correct roentgen diagnosis is briefly discussed, as well as the problem of therapy in these cases. The author feels that no general rules apply and that each case should be handled individually.

Four illustrations, including 2 roentgenograms.

JOHN H. JUHL, M.D.
University of Wisconsin

Sarcoidosis. A Clinical and Roentgenological Study of Twenty-eight Cases. John H. Moyer and Alfred J. Ackerman. Am. Rev. Tuberc. **61:** 299–322, March 1950.

The 28 cases of sarcoidosis included in this study were proved histologically. The ages ranged from fifteen to thirty-five with an average of twenty-three years. Intrathoracic manifestations were the most prominent and consisted of tracheobronchial and mediastinal lymph node and parenchymal lesions. The nodes are usually bilaterally and symmetrically enlarged and may reach the size of the large tumefactions commonly seen in lymphosarcoma and Hodgkin's disease. Pulmonary parenchymal involvement which frequently accompanies the adenopathy usually takes one of three general forms. The first, diffusely disseminated small nodular infiltrations, resembles the picture of acute miliary or chronic hematogenous forms of tuberculosis. The second, peribronchial fibrous infiltrations, may be diffuse or localized, and the third, coalescent patchy infiltration, is most frequently seen in the central lung fields. These lesions are often found in combination, with little correlation between clinical and roentgen findings.

Cardiovascular involvement is present in approximately 10 per cent of cases and consists of actual involvement of the myocardium by the granulomatous lesions or cor pulmonale secondary to widespread involvement. Changes in the electrocardiogram and changes in rhythm are the most common clinical manifestations.

Bone involvement was present in only 3 per cent of the authors' cases. The lesions, resembling small cysts, are usually found in the phalanges. A type with small circumscribed lesions and a diffuse form are described. The former is limited to the cancellous portion of the bone, while the latter tends to widen the shaft and thin the cortex, producing a somewhat reticular pattern due to the multiple rarefactions.

The lymphatic system is involved in almost all cases of sarcoidosis at some time during the course of the disease. Incidence of intrathoracic involvement is 85 per cent, with peripheral nodes affected in 75 per cent of cases; the enlargement is usually not marked. Hepatic involvement is difficult to determine, since hepatomegaly may or may not be present. As determined by liver function tests, 8 out of 12 cases studied in the present series showed abnormalities, but signifi-

cant increase in serum globulins was present in only 20 per cent of the cases.

Skin involvement was present in only 14 per cent, parotid gland changes in 10 per cent, and eye abnormalities in 18 per cent of the reported cases. No nervous system lesions were found. The pathology is briefly discussed and emphasis placed on the presence of caseation in the nodular lesions. Definite diagnosis can be established only by a biopsy, but chest findings as noted on the roentgenogram are often of considerable help.

Twenty-one roentgenograms; 2 photomicrographs; 3 electrocardiograms.

JOHN H. JUHL, M.D.
University of Wisconsin

Bronchopulmonary Mycosis. Simultaneous Primary Occurrence in Four Children and Their Mother with Subsequent Healing by Diffuse Miliary Calcification; A Twelve Year Observation. Brenton M. Hamil. Am. J. Dis. Child. **79:** 233–271, February 1950.

Five cases of bronchopulmonary mycosis due to *Monila pinoyi* and *Aspergillus niger*, in 4 children and their mother, are reported in considerable detail. A discussion of the roentgenologic aspects of these cases has been presented previously (Doub: Radiology **51:** 480–490, October 1948).

Thirty-two roentgenograms; 5 tables.

Impairment of Pulmonary Function in Anthracosilicosis. Hurley L. Motley, Burgess Gordon, Leonard P. Lang, and Peter A. Theodos. Arch. Indust. Hyg. & Occup. Med. **1:** 133–157, February 1950.

Anthracosilicosis is a disabling occupational disease characterized by progressive dyspnea, intercurrent respiratory infections, and failure of the pulmonary circulation. The impairment of breathing is related primarily to the amount and distribution of fibrosis resulting from the inhalation of dust containing silica, although carbon also may exert an effect.

The impairment of pulmonary function was evaluated by physiological measurement of the ability of the organism to transport oxygen into and remove carbon dioxide from the blood during rest and exercise while breathing air. It was found that the degree of emphysema, as measured by expressing residual air as a percentage of total lung volume, is very significant. There is no apparent correlation between the stage of silicosis as observed on a roentgenogram and the impairment of pulmonary function in many cases. In some instances there was evidence of extensive involvement on the roentgenogram and very little functional disturbance, while in other cases with minimal roentgenologic changes the pulmonary function was greatly decreased.

Eight charts; 5 tables.

HOWARD L. STEINBACH, M.D.
University of California

Chronic Pulmonary Beryllosis in Workers Using Fluorescent Powders Containing Beryllium. H. E. MacMahon and H. G. Olken. Arch. Indust. Hyg. & Occup. Med. **1:** 195–214, February 1950.

Chronic pulmonary beryllosis is characterized by a non-productive cough, progressive dyspnea, and marked loss of weight. The disease may last, with remissions and exacerbations, for months and years, with an extreme degree of dyspnea, cyanosis, and cachexia during the terminal phase. The inhalation of dust containing beryllium is probably responsible for the condition, but since so many workers are not affected, the susceptibility to beryllium may be a significant factor.

The gross pathological changes are most marked in the lungs, pleura, and regional lymph nodes. The picture is one of long-standing granulomatous inflammatory reaction, most marked in the lower lobes. There are great destruction of the lung parenchyma, severe emphysema, and an irreparable loss of much of the capillary bed.

Two fatal cases of chronic pulmonary beryllosis in young women who were employed in the manufacture of fluorescent lamps are reported. The roentgenograms in the first case demonstrated symmetric haziness, most marked in the bases of the lungs. The chest films of the second patient showed emphysema of the upper lung fields and a coarse granularity and nodularity of the lower portions of the lung parenchyma.

Five roentgenograms; 10 photomicrographs; 3 photographs.

HOWARD L. STEINBACH, M.D.
University of California

Pulmonary Disease, Associated with Cystic Fibrosis of the Pancreas. Lloyd B. Dickey. Dis. of Chest **17:** 151–166, February 1950.

Chronic pulmonary infection associated with cystic fibrosis of the pancreas has been recognized as a clinical entity for over a decade. In any child with a chronic respiratory infection, especially if it extends from the tip of the nose to the alveoli, with sputum and a negative tuberculin reaction, this disease should be thought of at once. It is of fairly common occurrence and probably accounts for at least 4 per cent of all deaths in children. The author presents a series of 10 cases seen over a period of seven years in the Department of Pediatrics, Stanford University School of Medicine. Four case histories are given in detail.

The typical symptoms are early failure to gain weight on an adequate diet, with unimpaired appetite, with steatorrhea, followed by symptoms of chronic respiratory infection. On physical examination signs of infection are found, usually along the entire respiratory tract, practically always in the lungs. An examination of the duodenal contents shows absent or greatly diminished trypsin activity and is always necessary to establish the diagnosis.

The roentgen findings are extensive. Barium in the intestinal tract may reveal complete obstruction during the neonatal period if the mucus in the meconium is viscid enough to cause meconium ileus. This condition is fatal and is present before pulmonary disease is manifest. If the condition is less severe, the typical picture of vitamin deficiency may show in the intestinal tract as "laking," with air and fluid levels and markedly slow bowel motility. The loops are dilated, and the distal small bowel is obviously smaller than the distended portions.

Neuhauser describes the extensive pulmonary changes and divides them into two stages. In the first there is evidence of bronchial plugging without much infection. There is flattening of the diaphragm, and many portions of the lung will appear emphysematous. There may be bulging of a few or many of the intercostal spaces. The lungs remain hyperexpanded in expiration, and the picture of obstructive emphysema with poor air exchange may be recognized. Areas of lobular atelectasis may be present, and lobar collapse is frequent. The second stage shows infection supervening, with increased hilar shadows and prominence of

the bronchovascular markings. Thickened bronchial walls may occasionally be seen and areas of peribronchial increased density. Although bronchiectasis is usually present, Neuhauser does not believe lipiodol injection to confirm this is warranted. The patient with long-standing pulmonary disease shows irregularly emphysematous lungs with prominent hilar shadows and bronchovascular markings, extensive peribronchial pneumonia, areas of atelectasis, bronchiectasis, and bronchiectatic abscesses. The apices and bases are equally involved, and the infiltration often extends to the periphery of the lung with no evidence of pleural reaction. All of these changes are non-specific, but certainly suggest the diagnosis.

Among the diseases to be included in the differential diagnosis is celiac disease, but this appears later in infancy, pulmonary symptoms are usually not outstanding, and trypsin is not absent or diminished in the duodenal contents. Chronic specific infections such as tuberculosis, coccidioidomycosis, pertussis and syphilis may be differentiated by specific tests. Other conditions to be ruled out are allergic asthma, unresolved pneumonias, enlarged thymus and foreign bodies in the respiratory tract.

Because *Staphylococcus aureus* is usually present in the respiratory secretions, penicillin by aerosol is the drug of choice, and streptomycin should be added if other pathogenic organisms which are penicillin-resistant replace the original invaders. Aureomycin and other antibiotics will probably soon have a place in the treatment of this disease.

Vigorous prophylaxis should be practised against the common cold and its complications, and against other specific respiratory infections, especially measles and pertussis. The patients should be kept under constant supervision at all times.

Ten roentgenograms; 4 photographs.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Pulmonary Nodules Associated with Mitral Stenosis. Stanley H. Sahn and Ida Levine. Arch. Int. Med. **85:** 483–489, March 1950.

Disseminated miliary nodules may be present in the lungs of patients with long-standing mitral stenosis. These may appear roentgenologically as very fine, soft, miliary stippling or calcified miliary or submiliary opaque areas. The basic pathologic changes are the same, irrespective of the density of the shadows. These consist of a combination of hemosiderosis, fibrosis, chronic congestive changes, and engorged vessels, with the calcification and ossification representing a more extreme reaction to the degenerative changes. Patients with pulmonary calcification should be given skin tests with old tuberculin, histoplasmin, and coccidioidin before a final diagnosis is made.

Two cases of pulmonary nodules associated with mitral stenosis are presented.

Four roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

A Case of Generalized Hemangio-Sarcomatosis Erroneously Considered as Generalized Tuberculosis. Martha D. Collins and Hyman Fisher. Am. Rev. Tuberc. **61:** 257–262, February 1950.

A case of generalized hemangiosarcomatosis (Kaposi sarcoma) with initial symptoms simulating tuberculosis is reported. The patient, a 25-year-old male, was admitted to a Veterans Tuberculosis Hospital. Because of blood-streaked sputum, evidence of pericarditis, pleural effusion, several sputum smears positive for acid-fast bacilli, and mottled densities scattered throughout the lung fields, a diagnosis of tuberculosis was made and streptomycin was administered. Failure to respond to the drug, progression of the disease, and development of scalp lesions suggestive of Kaposi sarcoma plus persistent failure to demonstrate the tubercle bacillus on culture and guinea-pig inoculation led to a diagnosis of malignant growth. Death occurred within six months of the onset of symptoms. Autopsy revealed a tumor in the deep tissues of the neck on the left, with multiple metastases. It was made up of large sinuses filled with blood, as well as a finer capillary mesh which invaded widely and was found within normal veins. The lesion was believed to represent a Kaposi sarcoma originating in the neck and metastasizing widely.

Four roentgenograms; 4 photomicrographs.

JOHN H. JUHL, M.D.
University of Wisconsin

Bronchiectasis Associated with Anomaly of the Right Pulmonary Vein and Right Diaphragm. Report of a Case. Emerson H. Drake and Joseph P. Lynch. J. Thoracic Surg. **19:** 433–437, March 1950.

A case is reported of a young man with cough of five years duration, productive of a half cupful of purulent sputum daily. Roentgen examinations showed a dextrocardia and bronchiectasis of the anterior basic division of the right lower lobe. Thoracotomy revealed a combination of congenital anomalies. There were absence of a true middle lobe, duplication of the posterior portion of the right diaphragm, and an anomalous inferior pulmonary vein which penetrated the diaphragm to empty into the inferior vena cava. The right lower lobe was excised without sacrificing the anomalous vein. The accessory segment of the diaphragm was also excised. The patient had an uneventful convalescence and a year later was asymptomatic except for a slight cough.

The discussion includes a review of the embryology of the lung, explaining the vascular anomaly encountered here.

Three roentgenograms; 2 drawings.

HAROLD O. PETERSON, M.D.
University of Minnesota

Broncholithiasis. Herbert W. Schmidt, O. Theron Clagett, and John R. McDonald. J. Thoracic Surg. **19:** 226–243, February 1950.

Since broncholiths are foreign bodies of an irritative nature in the tracheobronchial tree, the symptoms consist primarily of cough, expectoration, and hemoptysis. Some patients also have fever, chills, and pleuritic pain. Physical findings are not particularly diagnostic, unless the broncholith causes a high degree of bronchial obstruction, in which instance the findings will be those of lobar collapse. The roentgen picture is usually not very suggestive of the true nature of the lesion. Among 41 cases constituting the authors' series, the roentgenologist suspected broncholithiasis in only 3 instances. Probably the most significant roentgen finding was the presence of a dense area of calcium deposition at the apex of a triangular portion of collapsed lung, this apex being located at the mediastinum. Broncholithiasis

may cause pulmonary abscess or empyema. If the broncholith is small, roentgen examination of the chest is usually negative.

In this series, the usual clinical impression after the history, physical examination, and roentgen study had been completed was bronchiogenic carcinoma. Bronchoscopic examination was then done, with 91 per cent positive findings. In over half of these cases, the broncholith was either found and removed or coughed up immediately after the procedure. In most of the remainder, the involved bronchus was found to be narrowed or obstructed by granulation tissue.

In 10 cases, surgical resection of part or all of a lung was done. The authors feel that any surgical procedure for this type of lesion should be as conservative as possible, since there may be multiple sites of origin.

The cause of broncholithiasis is either calcareous or osseous change in peribronchial lymph nodes subjacent to larger bronchi, or similar changes in bronchial cartilages. The former is produced by tuberculosis most frequently, and also possibly by coccidioidomycosis and histoplasmosis. The other process (*i.e.*, change in bronchial cartilage) is a senescent change.

Nineteen illustrations, including 14 roentgenograms; 1 table.

HAROLD O. PETERSON, M.D.
University of Minnesota

Roentgenologic Manifestations of Parasternal Omental Hernia. John S. Stewart. J. Thoracic Surg. **19:** 399–404, March 1950.

The roentgen findings of parasternal omental hernia are: (1) a soft-tissue density at either cardiophrenic angie, (2) cephalad and anterior displacement of the transverse colon, which assumes the contour of an inverted "V" or "U," (3) presence of air within the soft-tissue mass following pneumoperitoneum.

The author describes three cases. In two, all the criteria were satisfied. In one, only the first of the above findings was present. Exploratory thoracotomy showed a typical hernia, however. In two of the cases, the hernial mass extended up between the middle and lower lobes of the right lung. This could be demonstrated by bronchography.

Nine roentgenograms.

HAROLD O. PETERSON, M.D.
University of Minnesota

Endothelioma of the Pleura. Report of a Case. P. H. Buxton and A. Willcox. Brit. M. J. **1:** 281–282, Feb. 4, 1950.

Endothelioma of the pleura is a rather rare tumor, usually characterized by a rapid down-hill course with increasing dyspnea and chest pain caused by massive pleural thickening and effusion. The case reported here was unusual in that effusion was practically absent and pain was never a prominent symptom. A chest film showed two rounded shadows on the left side and a lateral view revealed two additional shadows lying anteriorly. Sections of the tumor were characteristic, showing spindle-shaped cells in whorls and sometimes appearing to line clefts. Only one metastasis was found, in a lymph node at the bifurcation of the trachea, but there were multiple tumors on both visceral and parietal pleural surfaces. Death occurred seven months after thoracotomy.

One roentgenogram; 1 photomicrograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

X-Ray Cinematography in Congenital Heart Disease. Robert Janker. Lancet **1:** 160–161, Jan. 28, 1950.

Janker states that at Bonn roentgen cinematography with the injection of radiopaque substances has replaced serial radiography in the diagnosis of congenital cardiac lesions. The applications and results of the method are discussed briefly. A description of the apparatus appears elsewhere (Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 513–520, 1950. To be abstracted in Radiology). The number of frames which can be exposed per second depends on the patient's size and build; it is usually eighteen but occasionally twenty-four. It is hoped to increase this number by raising the voltage. At present, much the same effect is achieved by incorporating a specially constructed copying apparatus, by means of which each frame exposed is copied up to twenty times; thus the whole process is "stretched out" in projection, which is a great help in diagnosis. Further improvements may be expected from the introduction of stereoscopic films, which are now still in the experimental stage.

Calcified Cardiac Aneurysms. A. Bogoch and E. F. Christopherson. Ann. Int. Med. **32:** 295–308, February 1950.

In the majority of cases, cardiac aneurysms follow myocardial infarction. The remaining few are due to syphilis (gumma), bacterial infection (abscess or embolus), or rheumatic myocarditis, or are of congenital or traumatic origin. The aneurysm is usually not sharply demarcated from the main ventricular cavity. It may be saccular and communicate with the cavity by a definite neck or orifice. It varies from a few centimeters in diameter up to a dilatation equal in size to the remainder of the ventricle. The pericardium over the bulge is often adherent and the interior of the sac usually contains thrombus, which may be laminated and organized.

Calcification in the wall of such an aneurysm is a relatively uncommon occurrence. It should be differentiated from calcified pericardium such as may occur in constrictive pericarditis. In aneurysm, the calcified shadow is usually linear, limited to the left ventricle, and situated within the heart contour. Pericardial calcification produces a thicker and more irregular shadow not restricted to the left ventricle and situated outside the outline of the heart.

The diagnosis of cardiac aneurysm is difficult, since the symptoms and clinical findings are so indefinite. In the majority of cases, a history points to a previous attack of coronary occlusion, and often to an inadequate period of bed rest. When symptoms are present, they are those of heart failure. The aneurysm itself does not alter the clinical course. Generally, the deciding factor appears to be the functional capacity of the rest of the ventricle. Some patients remain surprisingly well and able to carry on a comparatively active life.

Many different physical signs have been described, including various murmurs and arrhythmias. These are of little or no aid in the diagnosis. The blood pressure is variable.

Electrocardiographic tracings usually reveal evidence of a preceding myocardial infarction.

The chief reliance for the diagnosis of cardiac aneurysm is placed upon radiologic examination. The heart is usually, though not always, enlarged to the left. The apex appears broadened or blunted, giving the heart a square or rectangular appearance. It is

often difficult, however, to differentiate this from the heart seen in hypertension or aortic insufficiency. The *most characteristic finding is a localized bulge occurring anywhere in the contour of the left ventricle.* An aneurysm of the anterior wall is clearly seen in the right anterior oblique position, in which case the upper margin forms an abrupt ledge or shelf on the anterior contour of the heart. An aneurysm of the posterior wall is best visualized in the left anterior oblique position. Posterior wall aneurysms may displace the esophagus. Apical aneurysms may be difficult to visualize, for the bulge may lie against the diaphragm and be obscured by its shadow. The pulsations of the aneurysm may be noted on fluoroscopy with the diaphragm depressed in full inspiration and may be recorded by kymography. They may be strong or weak, synchronous or asynchronous, systolic or contrapulsile. In the majority of cases, asynchronicity with contrapulsile pulsation is present. Calcification, when it occurs, is an invaluable diagnostic aid.

Death is usually due to congestive heart failure or to further coronary artery occlusions. Rupture of a cardiac aneurysm is a rare occurrence. Some patients succumb to cerebral embolism from a dislodged fragment of clot.

Two cases of calcified cardiac aneurysm are reported in detail.

Nine roentgenograms; 1 photograph; 1 electrocardiogram.

STEPHEN N. TAGER, M.D.
Urbana, Ill.

Study of Cardiac Enlargement in Infancy with Case Reports of Reversible Enlargement. Hyman Green and John Apley. Pediatrics **5:** 249–256, February 1950.

The authors report three cases of prolonged cardiac enlargement and eventual return of the heart to normal size. Two of the patients had pulmonary infections; the third had no associated abnormality.

In order to ascertain the incidence of cardiac enlargement in infancy, chest roentgenograms of 1,000 consecutive infants were made. Cardiac enlargement was present in 16. Of these, 7 died shortly after birth. Of the 9 survivors, 2 were inadequately followed, 5 had congenital cardiac malformations, and 2 showed recovery with normal hearts.

Next, 29 cases of gross cardiac enlargement were studied among infants coming to autopsy in the neonatal period. Of these, 10 had pathologic lung conditions, 8 had cardiac malformations, 6 had erythroblastosis fetalis, and 5 constituted a miscellaneous group. This study was of interest in demonstrating the fact that cardiac enlargement in infants coming to autopsy was more frequently due to causes other than congenital malformation. It is suggested that "idiopathic cardiac enlargement" may be due to rare diseases and that, when the pathologic condition subsides, the cardiac enlargement may be reversible.

Six roentgenograms.

PAUL W. ROMAN, M.D.
Baltimore, Md.

Lutembacher's Syndrome Associated with Dextrocardia. Irving Innerfield. Arch. Int. Med. **85:** 490–495, March 1950.

A case of interauricular septal defect combined with mitral stenosis and associated with dextrocardia is reported.

The patient was a 20-year-old male who complained of easy fatigability and moderate dyspnea upon exertion. A roentgenogram revealed dextrocardia, a greatly enlarged right ventricle, a small aorta, a markedly prominent pulmonary artery, and engorged hilar vessels. Fluoroscopic examination showed a hilar dance. The observations on venous catheterization were considered compatible with a diagnosis of interauricular septal defect. The nail beds appeared cyanotic, and questionable clubbing of the fingers was observed. The chief electrocardiographic findings were pronounced right axis deviation and an interventricular conduction defect.

The diagnosis is a clinical one and has not been proved morphologically.

One roentgenogram; 1 electrocardiogram.

HOWARD L. STEINBACH, M.D.
University of California

Right Heart Catheterization of the Aorta through a Patent Ductus Arteriosus. Report of Two Cases. Forrest H. Adams, John LaBree, and Herbert M. Stauffer. Pediatrics **5:** 390–395, March 1950.

Cardiac catheterization is of value in demonstrating a patent ductus arteriosus. In this condition the oxygen content of the blood in the pulmonary artery is greater than in the right ventricle, indicating a shunt of blood from the aorta to the pulmonary artery. Three cases are presented in which the catheter passed from the pulmonary artery through a patent ductus into the aorta. One of these patients was shown to have a right descending aorta in the presence of a left aortic arch.

Five roentgenograms; 2 drawings.

HOWARD L. STEINBACH, M.D.
University of California

Studies of Congenital Heart Disease. IV. Uncomplicated Pulmonic Stenosis. J. W. Dow, H. D. Levine, M. Elkin, F. W. Haynes, H. K. Hellems, H. W. Whittenberger, B. G. Ferris, W. T. Goodale, W. P. Harvey, E. C. Eppinger, and L. Dexter. Circulation **1:** 267–287, February 1950.

Although simple pulmonic stenosis has been considered a rare form of congenital heart disease, experience with cardiac catheterization is revising that opinion. Eight cases studied in great detail form the basis of this report. In none of these was there a very high degree of stenosis. Cyanosis and clubbing may appear late, the cyanosis being the result of poor peripheral circulation, since there is no shunt.

When cardiac failure occurs the lungs remain clear; the congestion is in the systemic circulation. The murmur is a systolic one, transmitted over the precordium and back but not into the neck, and bears no relation to the severity of the stenosis. Occasionally there is also a diastolic murmur from insufficiency. The pulmonary second sound may be normal, decreased, or increased in intensity.

The characteristic x-ray findings are (1) enlargement of the main pulmonary artery (post-stenotic dilatation), (2) normal or decreased vascular markings in the lungs, (3) normal left auricle and ventricle, and (4) if stenosis is severe or long standing, enlargement of the right ventricle and auricle.

Pathologically the stenosis may involve the valve or the infundibulum or junction between the infundibulum

and the main part of the right ventricle. Subacute bacterial endocarditis is a common complication.

Anyone interested in congenital heart disease should read the article in the original.

Four roentgenograms; 3 electrocardiograms; 1 graph; 3 tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Familial Hemorrhagic Telangiectasia with Associated Pulmonary Arteriovenous Aneurysm. H. L. Armentrout and F. J. Underwood. Am. J. Med. **8:** 246–254, February 1950.

Pulmonary arteriovenous aneurysms frequently are associated with telangiectasia elsewhere on the body. Two such cases with a familial background are reported. These were seen, along with a third case in which heredity was not known to play a part, during the course of a year at the University of Oregon Medical School, Hospitals and Clinics.

One patient had telangiectasis of the skin, tongue, mucous membranes of the mouth and the stomach. She experienced epistaxis, gastro-intestinal hemorrhage, anemia, and enlargement of the liver and spleen. The other patient had telangiectasis of the skin of the hands, face and feet, and of the buccal and nasal mucous membranes. She was cyanotic, with early clubbing of the fingers.

Roentgenologically both patients showed fairly discrete pulmonary densities communicating with the hilus through large vascular shadows. Angiocardiograms demonstrated simultaneous filling of the aneurysms and the pulmonary artery.

Four roentgenograms; 5 photographs.
HOWARD L. STEINBACH, M.D.
University of California

Dilatation and Pulsation of the Left Subclavian Artery in the Roentgen-Ray Diagnosis of Coarctation of the Aorta. Roentgenkymographic Studies in Thirteen Cases. Herbert M. Stauffer and Leo G. Rigler. Circulation **1:** 294–298, February 1950.

Special attention to the left border of the superior mediastinum gives valuable confirmation when coarctation of the aorta is suspected. On plain postero-anterior films there is usually widening of the left upper mediastinal shadow attributable to enlargement of the left subclavian artery. Fluoroscopically and on roentgenkymography, pulsation of this vessel may be seen (ordinarily pulsation is not detectable).

In the authors' series of 13 patients, 12 gave roentgenkymographic evidence of pulsation. In 3 of these rib notching was absent or equivocal. In a series of 50 roentgenkymograms made in other cardiovascular conditions only one showed pulsation of the left subclavian. This was a case of hypertension and aneurysmal dilatation of this vessel but without other signs of coarctation.

One case of the authors and one reported in the literature (Schatzki and Hallermann: Forstschr. a. d. Geb. d. Röntgenstrahlen **42:** 324, 1930) had the coarctation above or at the origin of the left subclavian but still showed a dilated pulsating vessel above the aortic knob, presumably the left common carotid.

[This should prove to be a valuable sign in routine examinations as well as in suspected coarctation.]

Eleven roentgenograms.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Congenital Aneurysm of Superior Vena Cava. Report of One Case with Operative Correction. Osler A. Abbott. Ann. Surg. **131:** 259–263, February 1950.

Primary aneurysms of venous structures are of considerable rarity. The author has not been able to find any report of a case similar to his.

The patient, a 19-year-old student, was subjected to a very intensive roentgen-ray investigation. Fluoroscopy and films of the chest demonstrated a unilateral enlargement of the superior mediastinum on its right side. This mass appeared to lie anteriorly, was sharply outlined laterally, but could not be seen on the medial border. It changed shape markedly when visualized in deep inspiration and deep expiration. A further change of shape from the standing to the horizontal position was noted. The mass was of homogeneous density and contained no calcium. It appeared to move paradoxically in relation to the aortic pulsations. It could not be determined whether the movements were due to intrinsic or transmitted pulsations. There was no displacement of the trachea or esophagus.

Angiocardiograms of the heart and great vessels were made in the right posterior oblique position after the injection of 70 per cent diodrast into the right antecubital vein. The contrast medium appeared to show a fusiform dilatation of the superior vena cava. A part of this dilatation probably also included the right innominate vein. The vena cava had a transverse diameter of 5 cm., contracting to apparently normal size just before entry into the heart. The borders of the mass could be seen extending approximately 1 cm. beyond the border of the opaque column in some areas. This was held to indicate either that the vena cava had a thick wall or that there was compression of the vena cava, causing its dilatation through broadening and flattening by an extravascular mass. There was no apparent obstruction to the passage of the opaque medium. The examination disclosed no other abnormal findings in relation to the cardiac chambers, pulmonary vascular bed, or first portion of the aorta.

An exploratory thoracotomy revealed multiple small aneurysms on the anteromedial surface of the large aneurysmal area in the superior vena cava, and this aneurysmal enlargement was also found to involve the proximal 2 cm. of the major azygos vein as it entered into the superior vena cava.

Six roentgenograms. DANIEL WILNER, M.D.
Atlantic City, N. J.

Resection of an Aneurysm of the Arch of the Aorta with Preservation of the Lumen of the Vessel. Olivier Monod and André Meyer. Circulation **1:** 220–224, February 1950.

The authors' patient was a woman twenty years old with no evidence of syphilis but with a moderately large saccular aneurysm of the aortic arch. This was originally mistaken for a mass of tuberculous lymph nodes, but after fifteen months in a sanatorium failed to demonstrate any tubercle bacilli, further studies were undertaken.

X-ray films of the chest revealed a roughly circular shadow just at the outside and to the left of the aortic arch, in the central part of the mediastinum. At 7.0 cm. from the dorsal plane, tomography showed this opacity to be in continuation with the opacity of the aorta. Except for this shadow, the chest was considered to be normal. The ribs were not notched

and fluoroscopy did not show any pulsation or expansion of the abnormality after induction of a left-sided pneumothorax. As a result of these studies, the probable diagnosis was mediastinal tumor of neurogenic origin. A pleuroscopic examination was then undertaken. The "tumor" was punctured under direct vision and the diagnosis of aneurysm was made. With the aid of Crafoord clamps, the surgeon was able to resect the aneurysm and close the defect without narrowing the lumen of the aorta.

Histologic examination gave no clue as to the etiology of the aneurysm but did reveal that all of the elements of a normal arterial wall were present though fragmented and scarred. [This suggests a congenital origin but the authors lean away from calling it congenital, postulating an embolus to the vasa vasorum or "arteritis resulting from variations in blood pressure." Z. F. E.]

Four roentgenograms. ZAC F. ENDRESS, M. D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Cardio-Esophageal Relaxation (Chalasia) as a Cause of Vomiting in Infants. William Berenberg and Edward B. D. Neuhauser. Pediatrics **5:** 414–420, March 1950.

Twenty-four infants with repeated vomiting apparently due to persistent relaxation of the hiatal portion of the esophagus, with failure of the gastric cardia to perform its usual "sphincter" action, have been observed by the authors during the past five years. The patients usually begin to vomit within three to ten days after birth. The vomiting appears to be effortless and is most apt to occur when the infant is in the supine or decubitus position.

Roentgen examination reveals diminished intensity and frequency of esophageal peristalsis. The esophagus appears as a dilated flaccid tube. During inspiration, barium regurgitates from the stomach to the esophagus. With expiration, the esophagus is compressed, with some barium passing to the mouth while some is forced back into the stomach. With the patient recumbent, slight pressure upon the abdomen causes retrograde filling of the esophagus.

Therapy consists of the use of thickened formulae and of keeping the patient in the erect position, particularly after feedings, for a period of three to four weeks.

Four roentgenograms; 1 photograph.
HOWARD L. STEINBACH, M.D.
University of California

Nonspecific Granulomatous (Regional) Esophagitis. R. H. Franklin and Selwyn Taylor. J. Thoracic Surg. **19:** 292–297, February 1950.

The authors describe 3 cases of esophageal lesions which on biopsy showed granulation tissue infiltrated with pus cells. Clinically, each case was characterized by dysphagia. Two of the patients were severely rundown from resultant malnutrition. X-ray examinations showed obstructive lesions in the esophagus. One patient was treated successfully by dilatations, with subsequent restoration of a normal roentgen appearance and complete clinical recovery. The other two could not be thus treated and were subject to surgical exploration and resection, with recovery.

The etiology of this condition is unknown. The ages of the patients were fifty-two, thirteen, and thirty-three years. In 2 of them the onset was preceded by a period of mental stress. Pathologically the condition is said to resemble Crohn's disease.

It is pointed out that these cases all mimicked cancer, both clinically and radiologically, and that the diagnosis of esophageal cancer cannot be made without biopsy.

Three roentgenograms.
HAROLD O. PETERSON, M.D.
University of Minnesota

On the Pathophysiology of a Peculiar Syndrome of Acute Abdominal Distension. Erik Ask-Upmark and Arne Frantzell. Acta radiol. **33:** 104–114, February 1950.

The authors discuss the considerable increase in abdominal circumference that has been observed in some individuals immediately after meals. In cases previously studied it was demonstrated that this increase is unassociated with aerophagia or acute ventricular dilatation, nor was any definite enlargement of the liver demonstrable on careful roentgen examination.

A case is now reported which is believed to add some information concerning this peculiar syndrome. The patient, a man of thirty-eight, gave a long history of digestive disturbances. More recently he had experienced an increase of 8 to 10 cm. in the circumference of the abdomen following his evening meal. This was provoked by practically any food substance except small quantities of milk or water warmed to body temperature. It could also be produced, by the patient himself or by the examiner, by exerting pressure high in the epigastrium in the midline. All laboratory tests were negative except the galactose tolerance test, which showed some impairment of liver function, possibly related to gastric hypersecretion.

Roentgen examination excluded aerophagia but furnished a completely satisfactory explanation for the distention. There was demonstrated, following the entrance of food into the stomach or mechanical pressure in the epigastrium, an immediate descent of the diaphragm, obviously of reflex origin. As a sequence of this changed position, the pressure in the abdominal cavity was increased and an increase in the circumference of the waist was brought about. This was facilitated by the presence of diastasis recti abdominis. The character of the reflex concerned is discussed.

In a supplementary note, the authors call attention to a report by Alvarez (Arch. Int. Med. **84:** 217, 1949) on non-gaseous abdominal bloating. In some of his cases descent of the diaphragm was noted but he did not hold this responsible for the bloating, which he attributed to a contraction of the muscles lining the abdominal cavity.

Seven roentgenograms. I. MESCHAN, M.D.
University of Arkansas

Symptomatology and Diagnosis of Gastric Cancer. John S. LaDue, Paul J. Murison, Gordon McNeer, and George T. Pack. Arch Surg. **60:** 305–335, February 1950.

The authors present an exhaustive study of 1,117 patients with gastric cancer treated at Memorial Hospital from 1916 to 1946; the signs, symptoms, gastroscopic, roentgenologic, and laboratory findings are evaluated diagnostically and prognostically.

The frequency and pattern of symptoms were the

same in both operable and inoperable cases, with the exception of dysphagia, which was twice as common in the inoperable group. Symptoms in decreasing order of frequency were weight loss, pain, vomiting, bowel disturbances, anorexia, dysphagia, nausea, weakness, eructation, hematemesis, and rapid satiation. Loss of over 41 pounds was usually associated with inoperability, but the rapidity of the loss and its percentage were more important than the absolute poundage in prognosis. Dysphagia was the first symptom in 40 per cent of patients with carcinoma of the cardia. Pain was more common in lesser curvature lesions; it may mimic angina. Anorexia was of more frequent occurrence in pyloric and prepyloric lesions.

The duration of symptoms had no relation to the operability, but surgical mortality was more than three times greater in the patients whose symptoms had been present from eighteen to thirty-six months as in those with a shorter history. Of 155 patients with histories longer than two years, 53 gave an ulcer-like story, while 102 had vague indigestion. Most of them experienced a change in symptoms which could have been an important clinical clue to the development of carcinoma. The presence of an epigastric mass was observed about equally frequently in the operable and inoperable cases. Aspiration biopsy of the liver may be useful when there are enlargement and nodularity of that organ.

Achlorhydria was present in 65 per cent of inoperable and 51 per cent of operable patients. Anacidity was associated with extensiveness of the lesion and anaplasia of the tumor; its incidence increased in proportion to the size of the tumor. Excessive acid was found in patients with benign ulcer twice as often as in those with cancer, and three times as often as in normal adults in the seventh decade. Low acidity was observed in about equal proportion in all three groups. Studies of the gastric aspirate by the Papanicolaou method was an important diagnostic aid. Anemia was not correlated with the achlorhydria, and responded poorly to iron therapy; when macrocytic, it was nearly always normochromic.

Roentgenologic studies led to a correct diagnosis in 91.5 per cent, and to an inconclusive report in 3 per cent. The study was reported normal in the other 5.5 per cent. With the open tube gastroscope the corresponding figures were 71.4 per cent, 9.9 per cent, and 18.6 per cent (161 patients), and with the flexible gastroscope 84.0 per cent, 11.1 per cent, and 4.9 per cent (144 patients). In a group of 305 patients the positive diagnoses were increased from 85 to 90 per cent with x-ray alone to 96.5 per cent when gastroscopy was also done. But, the authors conclude, no patient should be denied exploration in the presence of persistent symptoms even in the face of negative results from a battery of ancillary studies.

Nine charts; 8 tables

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Problems in the X-Ray Diagnosis of Cancer of the Stomach. S. Cochrane Shanks. Proc. Roy. Soc. Med. **43:** 117–128, February 1950.

In a case of cancer of the stomach, there occurs, on an average, an interval of three months between the onset of symptoms and the patient's first visit to his physician. There is usually a further interval of three months before a full clinical and radiological investigation is made. When one adds to these six months the earlier months when the cancer was present but asymptomatic, it becomes more apparent why the first x-ray examination may show an advanced lesion.

Six features which may give rise to difficulty in the radiologic diagnosis are discussed:

(1) *The Very Small Lesion:* Detailed studies of the mucosal pattern are most important in the demonstration of early and small lesions. The author quotes Berg's aphorism regarding the barium meal: "The less you give, the more you see." He himself feels strongly that the chance of discovering a small lesion is nullified by complete filling of the stomach with barium.

(2) *The Unusual Type of Lesion:* An example of the unusual lesion is the carcinomatous plaque, which may produce an appearance indistinguishable from a localized hypertrophic gastritis. Often it is not possible to differentiate between the two, and gastroscopic examination is most important. The x-ray picture shows a localized patch of coarse gastric rugae. A diffuse coarse pattern involving the whole stomach is unlikely to be a growth and may represent a mucosal reaction to a peptic ulcer.

(3) *The Site Difficult to Examine:* The cardia and fundus of the stomach are inaccessible to radioscopic palpation and a detailed study of the mucosal pattern is often not possible. The normal irregularity of the mucosal pattern, compared with the ordered symmetry of that of the lesser curvature, adds to the difficulty. Unfortunately, also, the cardia and surrounding fundus are blind spots to the gastroscope. The classic signs of a carcinoma of the cardia and fundus are "delay at the cardia, with the loss of the normal intermittent spurt, the splitting of the barium stream; the coating of the tumor mass and the absence of a regular mucosal pattern; the outlining of the tumour by the gas bubble and by barium in the supine view; the thickened diaphragmatic shadow above the fundus."

(4) *Pre-existing Deformity of the Stomach:* A cascade stomach may mask a lesion at the cardia, pars media, or pylorus. A hiatus hernia may add complications to the detection of a fundal growth. The pyloric antrum may become contracted and aperistaltic following a posterior gastrojejunostomy, thereby simulating a growth.

(5) *Pyloric Lesions:* Pyloric lesions are notoriously difficult to evaluate. The site is a common one for hypertrophic gastritis, and an uncommon one for simple ulcer. It is still a more common one for cancer. Often the lesion is readily demonstrated but its precise nature is difficult to determine unless by serial examination over many months, and gastroscopy. Spasm and gastritis of the pyloric antrum may simulate stenosing carcinoma. Although lesions on the greater curvature near the pylorus are most likely malignant, simple ulcers have been demonstrated in this region.

(6) *The Ulcer-Cancer Problem:* The author takes a dim view of the theory of frequent degeneration of the simple ulcer into a cancer. Clinical evidence is also against the peptic ulcer cancer sequence being a common one. The average history of symptoms in peptic ulcer is about five to seven years; in cancer it is about six months. If the majority of cancers supervened on simple ulcer, one would expect a longer history in the cancer groups. Again, the great majority of simple gastric ulcers are on the lesser curvature, while the pyloric antrum is the site of election for a cancer. It seems probable that not more than 10 to 15 per cent of gastric cancers arise from chronic ulcers. Curiously,

malignant change seems never to occur in duodenal ulcer, a much more chronic type.

Ulceration in an already existing tumor of some size usually makes the diagnosis clear. Any ulcer larger than 2.5 cm. in diameter should be suspected as malignant until it has been proved otherwise. The simple ulcer tends to be hemispherical, regular in contour, and sharply defined. Malignant ulcers tend to be irregular. The meniscus sign may differentiate a simple from a malignant ulcer; it consists of a translucent zone a few millimeters in width, separating the barium-filled crater from the main barium mass in the stomach, and is due to the hard growing malignant edge of the ulcer. Some chronic simple ulcers may show the same appearance if they have a very raised edematous edge. The site of the ulcer is important. A simple ulcer is usually on the lesser curvature, distant from the pylorus. A malignant ulcer is variable in site but is seen most commonly on the lesser curvature near the pylorus. Ulcers on the greater curvature are uncommon and nearly always malignant.

A therapeutic test may be of great value. A simple ulcer should heal in a few weeks under medical treatment, a malignant one will not. Again there is a reservation, for a malignant ulcer may temporarily become smaller during treatment. In simple chronic ulcer the rugae tend to converge to the crater. In malignant ulcer they are said to be interrupted without converging. This again is not always the case. Where a long-standing chronic ulcer has undergone malignant change, the rugae may converge to the crater as a result of scarring.

Twenty-seven roentgenograms.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Localized Walled-Off Gas-Pockets Due to Perforation Complicating Peptic Ulceration and Gastric Carcinoma. Maurice Feldman. Gastroenterology **14:** 201–212, February 1950.

The walled-off gas pockets described in this paper differ from the more common type of chronic perforation, such as the accessory pocket or pseudo-diverticulum portrayed as part of the ulcer crater. These pockets may contain air alone, barium alone, or both. They may be sealed or non-sealed. In the medical type a pinpoint perforation spontaneously seals, with only a small amount of air escaping. In the surgical type there is associated localized active peritonitis. The chronic pseudo-diverticulum does not ordinarily form a localized gas pocket, as the hiatus is large and barium filling occurs readily.

In the medical type of gas pocket described here, there is an abrupt or insidious blowout of the ulcer crater with spontaneous sealing. A small amount of air is trapped, close to but outside the lumen of the viscus, forming a pocket best visualized with the patient upright. In the stomach, the pocket lies adjacent to the ulcer crater (or somewhat distant, depending on the location of the ulcer). In the duodenum, the pocket lies above the superior duodenum in the subhepatic area. The contour of the pocket is smooth and the size usually small. The gas is gradually absorbed and may be missed if roentgen examination is delayed.

In the surgical type, the pocketing is more extensive and there is associated peritonitis. The perforation is usually not sealed, even though it is of only pinpoint size. The gas is not rapidly absorbed, as more or less continuous leakage occurs. The size of the opening and the surrounding edema may prevent the entrance of barium.

Five cases are presented.

Five roentgenograms; 1 photograph.

B. S. KALAYJIAN, M.D.
Detroit, Mich.

"Ball Fundus," a Symptom of High Gastric Stenosis. K. Lenggenhager. Schweiz. med. Wchnschr. **80:** 103, Feb. 4, 1950. (In German)

Basing his statements on two cases briefly reported, the author outlines the following syndrome as being characteristic of high gastric narrowing due to an overhang of the fundus on a band:

1. Immediately after one or two swallows, the patient experiences a feeling of fullness in the stomach, sometimes accompanied by air hunger, oppression, pressure about the heart, and vomiting.

2. Roentgenologically the apex of the stomach is seen to fill out in a globular fashion, with later passage of the meal through to the lower segment. In contrast to the ulcer type of "cascade stomach," the ball fundus is not eccentric. The findings are apt to be apparent on the screen only; the films may not show the characteristic picture. In lateral projection the fundus of the stomach hangs over like a bag under the diaphragm and empties through a narrow channel into the lower part. Operative division of the band of adhesions which causes the condition is indicated.

Five roentgenograms. LEWIS G. JACOBS, M.D.
Oakland, Calif.

Defective Fat Absorption Following Vagotomy. H. J. Fox and K. S. Grimson, with the technical assistance of Anne Jewell. J. Lab. & Clin. Med. **35:** 362–365, March 1950.

Fat balance tests were carried out on 9 normal persons and 9 patients who were experiencing symptoms indicating dysfunction of the small intestine following vagotomy. The normal controls absorbed more than 90 per cent of the fat ingested, while in all of the vagotomy group of patients except 1, less than 90 per cent was absorbed. The average fecal output in the vagotomy group was greater than that of the controls.

Roentgen studies showed localized dilated segments and coarsening of mucosal pattern in the small bowel in 4 of the 9 patients who had undergone vagotomy; no abnormalities of the stomach or small bowel were seen in the controls.

The logical explanation for the defective fat absorption observed following vagotomy would seem to be primarily an interruption of the parasympathetic nerve supply to the bowel, biliary tract, or pancreas.

Three tables.

Atypical Pyloric Stenosis. Report of Two Cases in Negro Infants in Whom Vomiting Began on the First Day of Life. Althea D. Kessler and Roland B. Scott. Arch. Pediat. **67:** 78–81, February 1950.

Typically congenital hypertrophic pyloric stenosis is seen in a white male infant from two to six weeks old. Two cases are here reported in Negroes, with vomiting beginning on the day of birth. One patient was male, the other female. Both were operated upon, and the typical hypertrophy of the pyloric muscle was found. On x-ray examination, one patient showed complete

retention of barium in three and a half hours (no mention is made of fluoroscopic findings). In the other only a flat film of the abdomen was obtained, suggesting a partial intestinal obstruction.

The author lists three precautions to be observed if barium is employed in the roentgen examination of newborn infants exhibiting vomiting: (1) Very thin barium mixtures should be used to avoid plugging or occlusion of stenosed areas in the alimentary canal. (2) Precautions should be taken to minimize the chances of aspiration of barium contained in the vomitus. (3) In evaluation of the "emptying time" of the infantile stomach, close observation and scrutiny are necessary to detect spurious partial or complete "emptying" by peroral vomiting.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Gallstone Intestinal Obstruction. Edward V. Denneen and Thomas C. Broderick. Ann. Surg. **131:** 225–236, February 1950.

Gallstone as a cause for intestinal obstruction is uncommon but not rare. The calculus enters the gastro-intestinal tract almost always *via* the gallbladder, although stones have been reported as passing through the papilla of Vater. In the latter case it is probable that the calculus increased in size in the intestine or caused obstruction through intestinal spasm. It is possible for a gallstone to ulcerate through the common duct into the intestine.

Stones usually enter the gastro-intestinal tract by way of the first or second portion of the duodenum but may enter the stomach or colon directly.

The usual sequence of events is "cholelithiasis, acute cholecystitis, gangrene and perforation of the gallbladder against the duodenum and pressure necrosis of the gallstone into the duodenum." The formation of the fistula and discharge of the gallstone presumably take at least several days. The gallstone may remain protruding into the duodenum, it may be incarcerated in the duodenum, or it may pass into the stomach and be vomited. Usually, however, it passes distally.

Usually a simple mechanical block occurs, to which may be added the complication of perforation and suppurative peritonitis. Intestinal spasm may complete the obstruction. Occasionally, according to Wangensteen, the obstruction partakes of the nature of a volvulus, the increased weight caused by the accumulation of fluid and gas above the point of obstruction producing torsion. Perforation may occur above the site of the gallstone due to extreme dilatation of the intestine proximal to the block.

Roentgenology is of the greatest help in diagnosis. Rigler, Borman, and Noble (J. A. M. A. **117:** 1753, 1941. Abst. in Radiology **38:** 631, 1942) studied 14 cases and found that roentgen examination alone could have made the diagnosis in 13. The roentgen criteria are well established:

(1) Air or contrast medium in the biliary tract; (2) direct visualization of the gallstone or indirect visualization by means of contrast medium in the intestine; (3) change of position of a previously observed stone; (4) evidences of partial or complete intestinal obstruction. Rigler and his associates found roentgenograms taken over the right upper quadrant in the anteroposterior and postero-anterior projections of greater value than films centered over the mid-abdomen.

The authors present 10 cases of gallstone intestinal obstruction. Diagnosis was established preoperatively in one case, where a calculus was visualized in the duodenum and barium was seen in the biliary tree. A roentgen diagnosis was not made preoperatively in any of the 9 cases of small intestinal obstruction but might have been in 3 of the cases, where a calcified mass was visualized and later proved to be a gallstone. In no case did a review of the films taken preoperatively show gas in the biliary tree.

Three roentgenograms; 1 photograph; 4 tables.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Retrograde Jejunogastric Intussusception: Report of a Case. Edwin H. Lawson and Donald L. Whitener. Arch. Surg. **60:** 242–246, February 1950.

Retrograde jejunogastric intussusception is an infrequent but serious complication of gastro-enterostomy, demanding prompt recognition and treatment. Its mechanism is not very clear; predisposing factors are an unusually large stoma, proximity of the two jejunal loops, and sudden increases of intra-abdominal pressure. The onset is marked by severe colicky epigastric pain followed by persistent vomiting, at first of clear liquid but later of blood-tinged material. There may be moderate to severe shock. An epigastric mass may be palpable.

Diagnosis is made by fluoroscopic and roentgenographic demonstration of a filling defect in the stomach, movable on palpation, with a uniform pattern of parallel curved lines suggestive of jejunal mucosa.

Although the mortality in unoperated cases is 100 per cent, 90 per cent of the patients treated by early operation have recovered.

The case reported here occurred five years after gastro-enterostomy for ulcer; diagnosis was made postmortem.

One drawing.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Observations on Small Intestinal Hypomotility and States of Hypertonicity Arising from Functional Bases. Lay Martin. Am. J. Med. **8:** 196–204, February 1950.

The cause of hypomotility of the small intestine is discussed on the basis of observations of 27 patients who had no evidence of organic disease. Hypomotility was determined by the presence of barium in the small intestine fourteen hours after ingestion and persisting two hours after a motor meal, a test which is applicable only to patients who have a gastric emptying time of less than five hours. Delayed motility was associated with physical and mental fatigue, low basal metabolic rate, and anxiety or tension states. The hypomotility was alleviated when these abnormal conditions were corrected.

Seventeen roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

Hypertrophic Ileac Stenosis Simulating Regional Enteritis. Report of a Case with Necropsy. Pearl M. Zeek and Louis G. Herrmann. Arch. Path. **49:** 150–158, February 1950.

A case of marked thickening of the terminal ileum due to hyperplasia and hypertrophy of the smooth muscle is presented. This was non-neoplastic and non-inflammatory, and was accompanied by changes in the myenteric nerve plexus.

The patient, a white boy who died at the age of twenty, complained of abdominal cramps, vomiting, and diarrhea intermittently for about five years. His terminal illness was due to complications arising as a result of the hypertrophic ileal stenosis. These consisted of a small sinus between the lumen of the ileum and the mesentery, resulting in a large mesenteric abscess which, in turn, had eroded into a major branch of the superior mesenteric vein. The resultant septic thrombophlebitis extended through the superior mesenteric, splenic, and portal veins with pyelophlebitic abscesses occurring in the liver. The portion of ileum and jejunum drained by the completely occluded part of the mesenteric venous circulation was gangrenous. Plain films of the abdomen taken during the terminal phase of the illness revealed a large liver and spleen. Several dilated, gas-filled loops of small intestine lay in the mid-abdomen. Only a small amount of air was demonstrated in the descending colon. Roentgen studies of the gastro-intestinal tract taken four years previously, when reviewed, showed several loops of terminal ileum with sharp, "spike-like" indentations and a slight alteration of the mucosal pattern.

Of interest was the occurrence of congenital pyloric stenosis in two siblings and Hirschsprung's disease in a third. Because of this, the authors conclude that the lesion probably is basically congenital in origin but possibly intensified during puberty by unknown factors affecting the autonomic nervous system.

Four illustrations.

HOWARD L. STEINBACH, M.D.
University of California

Roentgenological Diagnosis of a Meckel's Diverticulum. Miguel G. Elias and Philip Ladin. Am. J. Digest. Dis. **17:** 48–50, February 1950.

Meckel's diverticulum is a congenital anomaly due to a failure of the omphalo-mesenteric duct to close. It occurs as an out-pocketing of the terminal ileum somewhere in the last 18 to 36 inches, on the antimesenteric border. It varies in size, shape, and length, and may or may not have its own mesentery. Histologically it may show one or all of the layers of the normal ileum. The presence of the diverticulum gives rise to no symptoms. When these occur they are due to such complications as inflammation, peptic ulcer, and tumor formation. Hemorrhage is rather common and melena of undetermined origin coming in paroxysms, particularly in children, should make one suspect this condition.

The roentgenologic demonstration of Meckel's diverticulum is a rarity, probably because the diverticulum has a wide neck and empties too rapidly or because it is obscured by the small bowel.

The authors report the case of a patient, aged 29, who consulted his physician because of severe knife-like pains in the mid epigastrium appearing about two and a half hours after eating. There was no vomiting or history of constipation.

A gastro-intestinal series revealed hypermotility of the stomach, but no other evidence of disease. Large doses of belladonna and phenobarbital were given and two weeks later the examination was repeated, films being taken at hourly intervals. On the fourth-hour film a gourd-shaped out-pocketing of the small intestine was demonstrated, with a narrow neck and enlarged fundus, measuring about 3 1/2 inches in its widest dimension. A diagnosis of Meckel's diverticulum was made and proved at operation. The diverticulum was freely movable and was identical in contour with the shadow seen on x-ray examination.

Three illustrations, including 1 roentgenogram.

JOSEPH T. DANZER, M.D.
Oil City, Penna

Hirschsprung's Disease and Idiopathic Megacolon. Denis H. Thompson and Josse Kaye. South African M. J. **24:** 73–80, Feb. 4, 1950.

The authors cite the work of Swenson and Bill (Surgery **24:** 212, 1948) and Bodian, Stephens, and Ward (Lancet **1:** 19, 1950. Abst. in Radiology **55:** 781, 1950) and point to the changed outlook on Hirschsprung's disease, which can now be separated from idiopathic megacolon. In Hirschsprung's disease the symptoms start with constipation at birth, and gaseous and abdominal distention appear soon thereafter; in idiopathic megacolon, constipation is mild at birth and is usually easily overcome, though a more severe type develops after several months or years. Abdominal distention is also less frequent and of later occurrence in idiopathic megacolon.

A diagram of the innervation of the walls of the bowel, a schematic illustration of the difference between Hirschsprung's disease and idiopathic megacolon, and the following table furnish a complete picture of the two diseases. Hirschsprung's disease shows a narrowed distal segment and normal rectum, whereas in idiopathic megacolon the rectum is grossly dilated. Ganglion cells are present in normal numbers in the dilated bowel in Hirschsprung's disease but none are present in the narrowed segment.

	Hirschsprung's Disease	Idiopathic Megacolon
Passage of meconium	Delay	No delay
Gaseous distention	Early	Late
Acute intestinal obstruction	Early	Late (rare)
Borborygmi	Increased	Usually not increased
Flatus	Foul and copious	Rare
Rectal examination	Empty (loaded rectosigmoid felt through wall of rectum)	Loaded with hard feces
Inconstinence	Absent	May be present
Course of the disease	High mortality	Benign

A case of idiopathic megacolon is reported, with a full discussion of the radiologic findings.

Thirteen roentgenograms.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Further Development of the Gastric Balloon to Facilitate Intestinal Intubation. J. J. Wild. Surgery **27:** 245–253, February 1950.

The author describes a development in intestinal intubation which uses an elongated balloon paralleling the course of the tube in the stomach, called by him a "gastric ram."

The action of the ram is fundamentally different from that of the gastric balloon. The gastric balloon, a full-length blunt-ended condom, requires only a relatively small inflation pressure and takes a large volume of air before the stomach walls are fully stretched. The pyloric region is thus drawn onto the tip of the tube in a manner somewhat analogous to drawing a tight glove onto the finger. On the other hand the ram, upon inflation, extends considerably in length and only minimally in diameter, similar to a "sausage" balloon. An improved model was found to force the tip of the tube well beyond the pyloric region and into the second part of the duodenum.

Three illustrative cases are presented. A diagram showing the fluoroscopic manipulation of the "gastric ram" is also included.

Six roentgenograms.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Cystadenoma of the Pancreas. A Report of Two Cases Showing Calcification. Robert S. Haukohl and Abraham Melamed. Am. J. Roentgenol. **63:** 234–245, February 1950.

Benign cystadenomas of the pancreas though rare are believed by the authors to be of sufficient importance to be considered in the roentgen differential diagnosis of space-occupying upper abdominal lesions. About 60 cases have been reported. Only 11 per cent of these occurred in males.

Although pancreatic cystadenoma is a definite pathologic entity, little is known of its histogenesis. There are three principal theories of origin: (1) displaced embryonic cells; (2) neoplastic proliferation of the pancreatic acinar epithelium; (3) proliferation of the cylindrical pancreatic duct epithelium.

Grossly, the tumor is usually covered by a thin fibrous capsule, the external surface being irregular, presenting a polycystic surface. The cut surface also has a polycystic configuration producing a porous, honeycombed appearance. The supporting stroma is variable in amount but is commonly abundant, especially in the center of the mass. Microscopically the cysts are usually lined by a single layer of low cuboidal epithelium supported by a moderate amount of hyalinized or partially calcified stroma.

The roentgen features of pancreatic tumors depend upon the site of origin and the direction of growth. The localization of a soft-tissue mass in the region of the pancreas is possible by ascertaining the relationship to surrounding structures, namely, the colon, stomach, duodenum, etc.

A list of the roentgen signs of pancreatic neoplasm is given and the authors include renal and psoas changes as significant.

Two proved cases of benign pancreatic cystadenoma showing calcification are reported. One case received roentgen therapy empirically. Follow-up roentgen studies a few months later failed to show any appreciable change in the size, configuration, or number of calcifications, and the mass was approximately the same size as prior to roentgen therapy. There was, however, less local tenderness, and subjectively the patient was markedly improved. As the authors remark, however, this may well have been the result of more careful dietary management.

Seven roentgenograms; 5 photomicrographs; 1 photograph.

J. B. SCRUGGS, M.D.
University of Arkansas

Non-Filling of the Gallbladder. A Contribution to Contrast Study of the Gallbladder After the Water Test and Carlsbad Salt. Umberto Cocchi. Acta radiol. **33:** 115–129, February 1950. (In German)

The causes for failure of the gallbladder to fill with contrast medium are discussed, with particular reference to Hotz' study of 217 cholecystograms in the Roentgen Department of the University Hospital in Zürich. In 123 of these patients some degree of gallbladder filling was demonstrated; in the remaining 94 no filling was obtained. In 82 of the cases operated upon at the University Hospital, the roentgen diagnosis was confirmed. Methods which have been found to produce better visualization (trial of another opaque medium; re-examination) are considered, with particular emphasis on the value of the "water test" and the administration of Carlsbad salts. Both of these procedures have a concentrating effect upon the gallbladder, producing a positive cholecystogram, in one-fourth of the cases in which the first cholecystogram was "negative," and "denser shadows" in more than a half of the cases showing poor concentration of the medium. Thus, calculi were revealed in 7 per cent of the cases in which the diagnosis had been missed in the first examination.

Twelve cholecystograms; 4 tables.

Intramural Small-Cystic Diverticulosis of the Gallbladder. Åke Åkerlund and Ulf Rudhe. Acta radiol. **33:** 147–164, February 1950.

Earlier studies of outpouchings of the gallbladder mucosa are reviewed, with special attention to the report of Robertson and Ferguson (Arch. Path. **40:** 312, 1945), who, as a result of their observation of 495 gallbladders removed surgically or examined postmortem, suggested the term diverticula for these formations. They recognized three groups: (1) diverticula reaching the tunica muscularis, (2) diverticula found in the intramuscular lacunae, and (3) diverticula penetrating the muscular layer into the underlying connective tissue and possibly even to the serosa. They found that in approximately 50 per cent of all the gallbladders of persons over thirty there were herniations of the mucosa into the underlying layer of the wall, at times reaching as far as the peritoneal margin.

Increased pressure in the gallbladder is presumed to be the initial etiologic factor in the formation of gallbladder diverticula, their further development being due to the deficient functional adaptation of the mucosa to subsequent distention, with abnormal stretching of the walls. Whether there exist true congenital diverticula of the gallbladder remains open to question. The authors feel that at least they must be extremely uncommon.

Only two reports of intramural gallbladder diverticulosis were found in the radiological literature, by March and Ackerman respectively (Am. J. Roentgenol. **59:** 197, 1948; **60:** 256, 1948). The present authors report 1 case and describe a new roentgen finding which they feel to be typical of intramural diverticulosis of the gallbladder. This finding consists of a more or less continuous narrow streak of contrast immediately adjacent to the shadow of the gallbladder, following it for various distances and showing in places a suggestion of granulation or columnar structure. This radiological picture is due to the composite

effect of contrast filling of a large number of closely packed intramural diverticula.

The importance of diverticulosis of the gallbladder in the origin of aseptic cholesterol concretions is stressed.

Thirteen illustrations, including 9 roentgenograms.

J. B. SCRUGGS, M.D.
University of Arkansas

Operative Cholangiography Following Choledochotomy. Ivan Goni Moreno. Am. J. Surg. **79:** 436–438, March 1950.

The author describes his method of delineating the biliary tree by iodized oil during operation. The medium is injected either through the cystic duct or the common bile duct. At least two roentgenograms are made five minutes apart to rule out temporary spasm and inconstant defects. A special type of cannula is described for injecting the oil into the common bile duct. The information obtained from this procedure is felt to be of real value.

One roentgenogram; 2 drawings.

PAUL W. ROMAN, M.D.
Baltimore, Md.

Retroperitoneal Fatty Tumors: Report of a Case and Collective Review of the Literature from 1937 to 1947. Aaron A. Farbman. Arch. Surg. **60:** 343–362, February 1950.

A man of fifty-two complained of bloating for nine months, with constipation and inability to eat normal quantities of food. His abdomen had been large as long as he could remember. He was found to have a large left abdominal mass about the size of a football. Gastro-intestinal roentgenograms showed displacement of both small and large bowel far to the right; the descending colon, sigmoid, and rectum were greatly displaced, adjacent to the ascending colon. A pyelogram showed non-filling and distortion of the lower pole of the left kidney.

The tumor was removed surgically and found to consist of two masses, the combined weight of which was 29 pounds. Following operation the patient received 500 c.c. of pooled plasma. Six weeks postoperatively 500-kv. roentgen therapy was given, through five ports in ten treatments, "a 50 per cent skin dose" being given over each port. Persistent nausea and vague abdominal distress began about this time, and after three months there was a rapidly increasing jaundice, followed by coma and death. The pathological diagnosis was lipomyxosarcoma, and death was due to liver necrosis, probably resulting from homologous serum jaundice produced by the pooled plasma. No evidence of tumor was found.

About 300 cases of retroperitoneal fatty tumors have been reported; 53 were reported between 1937 and 1947. About half of this latter group had undergone malignant change. The age of the patients was usually between forty and sixty, and females predominated, about 2 to 1; in the benign tumors the ratio was 4 to 1, and in the malignant 1 to 1. The largest tumor reported weighed 56 pounds. Helpful in diagnosis are lipomatosis elsewhere, difference in temperature of the lower limbs, and roentgen signs of visceral displacement, unusual radiolucency of the tumor, and displacement of the kidney. Five tumors were inoperable; 4 patients died postoperatively, and of the remaining 44, only 25 were followed, 14 with benign and 11 with malignant tumors. Thirteen of these were living and well, but in 6 instances for less than a year. Of the 14 benign tumors, 6 recurred, 3 with sarcomatous change; of the 11 patients with malignant tumors, 6 died within eighteen months of surgical intervention. Two of the 5 living and 4 of the 6 dead had received x-ray therapy.

Five roentgenograms; 4 photographs; 6 tables.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Patent Omphalomesenteric Duct of an Adult. Sam F. Seeley, Irving R. Lyman, Edwin J. Pulaski, and John T. Ellis. Am. J. Surg. **79:** 458–461, March 1950.

Patent omphalomesenteric duct is a rare anomaly, found most frequently in the first year of life. Usually a fecal discharge is present and occasionally the ileum prolapses through the duct.

The case reported occurred in a 20-year-old male, who had noticed intermittent inflammation of the umbilicus. When admitted to the hospital, he complained of severe pain in the umbilical region, extending down the rectus muscles. There was a foul greenish discharge from the umbilicus. Penicillin was given, with resultant disappearance of the pain and inflammation. Then, under fluoroscopy, lipiodol was injected through a catheter into the umbilicus and was seen to pass into the lumen of the small bowel. At operation the duct was dissected down to the ileum, about 36 inches proximal to the cecum, and was excised. Pathologic study showed the duct to be lined by granulation tissue almost to the entrance into the ileum.

Seven illustrations, including 1 roentgenogram.

PAUL W. ROMAN, M.D.
Baltimore, Md.

THE MUSCULOSKELETAL SYSTEM

Myositis Ossificans Progressiva. Synonyms—Fibrositis Ossificans Progressiva. H. A. Thomas Fairbank. J. Bone & Joint Surg. **32-B:** 108–116, February 1950.

Myositis ossificans progressiva is a congenital affection characterized by the formation of bony columns in the soft tissues with progressive limitation of movement, usually associated with microdactyly.

Clinically, localized swellings in the region of the head or neck and trunk appear during infancy and childhood. These are followed by the development of irregular masses or plates of bone in the soft tissues, which seem to lie in the course of a muscle. Microdactyly is of diagnostic importance, occurring before the bony masses are laid down. The great toes are affected in about three-quarters of all cases.

Radiographically the density of the extra-skeletal bone varies. It may appear as sheets of bone, exostotic projections, subperiosteal thickenings, and fusion of vertebrae. Pathologically, the primary change occurs in the connective tissue, the muscle tissue being only secondarily involved.

Treatment has been unsatisfactory, but the author believes that the possibilities of radiotherapy have not been fully explored.

Four case histories follow, with 12 illustrations (6 roentgenograms).

ALBERT R. BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

Osteopathia Striata. H. A. Thomas Fairbank. J. Bone & Joint Surg. **32-B:** 117–125, February 1950.

Osteopathia striata is a rare condition characterized by vertical striations of the skeleton, particularly of the metaphyses of the long bones. It is believed by the author to be the result of a congenital developmental error.

The outstanding radiologic feature is the striation, which affects in varying degrees all of the bones except the skull and the clavicles. This may extend into the epiphyses. Between the striations the bone may be porotic. The bony cortex is usually normal.

Three cases are presented. One of these the author designates as generalized hyperostosis with striation of the bones. In this case there was thickening of the cortex of the long bones as well as striation.

Seventeen roentgenograms.

ALBERT R. BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

Infantile Cortical Hyperostosis. Review of the Literature and Report of Five Cases. Mary S. Sherman and David T. Hellyer. Am. J. Roentgenol. **63:** 212–222, February 1950.

Following a brief review of the literature, the authors report five additional cases of infantile cortical hyperostosis, making a total of 27 unquestioned cases in the literature.

In this disease initial symptoms usually appear within the first four months of life. Irritability, with or without fever, is usually the first recognized change. Shortly thereafter firm, tender swellings develop deep in the soft tissues, diffuse and brawny but not hot or red. There is no associated lymphadenopathy nor fluctuation. Associated findings may include anemia, leukocytosis with increased sedimentation rate, fever, and pleurisy. The disease runs its own course and spontaneous cure is the expected result, although repeated remissions and exacerbations are common.

Of the 27 cases in the literature, 15 have occurred in males and 12 in females. Cases have been reported from four separate countries and from eleven states in the United States. One case has been reported in a Negro and 1 in a Chinese. There are instances of more than one case occurring in a family, but not simultaneously. It has not been possible to relate this disease to rickets, scurvy, syphilis, tuberculosis, pyogenic infection, allergy, or trauma. Virus studies have been far from complete and further investigations along this line may be warranted.

Roentgenographically deposits of subperiosteal new bone are demonstrable both in the areas of swelling and also in some apparently uninvolved regions. These deposits may be too small to be felt or they may be so massive as to produce gross enlargement of the limb. They have been recognized in all parts of the skeleton except the phalanges, the small bones of the carpus and tarsus, the vertebrae, and the pelvis.

Seven roentgenograms; 3 photographs; 3 photomicrographs.

J. W. NELSON, M.D.
University of Arkansas

Osteogenesis Imperfecta Congenita: Report of a Case in a Negro Infant. Roland B. Scott and Clinton H. Wooding, Jr. J. Pediat. **36:** 381–384, March 1950.

A case of osteogenesis imperfecta congenita in a Negro infant is reported. The child had severe gross deformities of the extremities, in the form of abnormal curvatures and apparent shortening. Roentgenograms demonstrated osteoporosis, thinning of the cortex of the bones, multiple fractures of the long bones, ribs, and clavicles, and a mosaic or lacunar pattern of the skull. The sclerae were blue. This disease is believed to be particularly rare in the Negro race.

Three roentgenograms; 1 photograph.

HOWARD L. STEINBACH, M.D.
University of California

Arachnodactyly or Marfan's Syndrome. C. G. Lambie, K. E. Shellshear, and J. L. Shellshear. M. J. Australia **1:** 213–223, Feb. 18, 1950.

The literature on arachnodactyly or Marfan's syndrome is extensively reviewed. Besides the long, thin fingers and toes which give the condition its name, there are many associated abnormalities. All the long bones show increase in length and decrease in width. Ligaments are loose and muscles hypotonic. The skull may show various types of craniostenosis, while the thorax often presents a funnel-shaped depression of the sternum. Fingers may be webbed, subcutaneous fat is sparse, the ears are usually large, and hearing impaired. Numerous eye defects occur, including shallowness of the anterior chamber and dislocation of the lens.

In the cardiovascular system, septal defects may occur, as well as dilatation of the ascending aorta, constriction of the aortic arch, and medionecrosis of the aorta. Imperfect sexual development is common.

Arachnodactyly is the result of an hereditary congenital defect of the mesenchyme, as are a number of other generalized skeletal diseases. The differential diagnosis is discussed and two cases are reported in detail with photographs and roentgenograms. [It is unfortunate that the characteristic roentgenograms of the hands and feet were omitted.]

This article is recommended in the original to anyone interested in this rare condition. It includes an extensive bibliography.

Thirteen roentgenograms; 6 photographs; 1 diagram.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Osseous Gaucher's Disease. Report of Two Cases in Siblings. Gilbert L. Gordon. Am. J. Med. **8:** 332–341, March 1950.

Two cases of the so-called osseous form of Gaucher's disease occurring in a brother and sister, aged 57 and 51, are reported. In one case roentgen studies of the long bones revealed, in addition to changes compatible with Gaucher's disease, an atypical lesion in the distal left femur. Because of the possibility that this bizarre lesion was a giant-cell tumor, a biopsy was carried out; this showed Gaucher's disease with no evidence of giant-cell tumor.

Eleven illustrations, including 6 roentgenograms.

A Case of Engelmann's Disease. Progressive Diaphysial Dysplasia. R. Fawcett Stronge and H. B. McDowell. J. Bone & Joint Surg. **32-B:** 38–39, February 1950.

A case of Engelmann's disease is presented, the first to be reported in a patient in the third decade of life. Radiographic studies showed symmetrical thickening of the compact bone of the femora and humeri with widening of the bones, slight irregularity of the surface,

and narrowing of the medullary cavity. Other long bones were less markedly involved. The skull showed sclerotic changes in the frontal and occipital regions. The remainder of the skeleton was essentially normal. Bone from the upper third of the left tibia was of normal structure.

This case does not differ from those previously reported in the literature, except for the age of the patient.

Three roentgenograms.

ROBERT R. ROSEN, M.D.
Mt. Sinai Hospital of Cleveland

Long Bone Involvement in Sickle Cell Anemia. John R. Almklov, Arild E. Hansen, and Martin Schneider. Pediatrics **5:** 204–209, February 1950.

The roentgenologic changes seen in the long bones of patients with sickle-cell anemia are a reflection of two processes occurring in the bones: (1) hyperplasia of the marrow, resulting in widening of the medullary cavity of the bone and thinning of the cortex; (2) thromboses in the bone resulting in a thin or obliterated medullary cavity and thickening of the cortex. The findings depend upon which of the two processes is dominant.

The authors report the case of a 21-month-old Negro male in whom the thinning of the cortex of the right femur was so marked that pathologic fracture occurred. The fracture healed readily with appropriate treatment.

Three roentgenograms.

PAUL W. ROMAN, M.D.
Baltimore, Md.

Arteriography in Bone Tumours. Reynaldo dos Santos. J. Bone & Joint Surg. **32-B:** 17–29, February 1950.

The author has applied arteriography to a study of bone tumors and has been able to differentiate between benign and malignant tumors and osteomyelitis.

Newly formed vascular networks of even caliber, gross irregularity of structure, disordered branching of arterioles, and "blood pools" are the characteristic structural changes of malignant tissue, particularly sarcoma. Functionally there is a more rapid transit between the arterioles and the veins, without the interposition of capillaries.

Osteoclastomas show new vessel formation and "blood pools" but less rapid filling of the veins. Simple benign tumors do not contain new blood vessels and are often relatively avascular. The transit time of the contrast material is not altered.

In osteomyelitis there is no formation of new vessels, but there may be dilatation of existing vessels, which retain their orderly arrangement of successive branches of gradually decreasing diameter.

The author has used thorotrast for some of his contrast studies, and notes that the material can be seen in malignant tumors months later. He suggests that the reticulo-endothelial system may play a part in the genesis of osteoclastoma.

The 26 excellent reproductions supply convincing evidence to support the author's conclusions.

ROBERT R. ROSEN, M.D.
Mt. Sinai Hospital of Cleveland

Roentgen Appearance of Thyroid Metastasis in Bone. Robert S. Sherman and Morris Ivker. Am. J. Roentgenol. **63:** 196–203, February 1950

The authors report an analytical study of 35 proved cases of thyroid carcinoma metastasis to bone, investigating possible factors of constancy which are recognizable roentgenologically.

Constant observations were: (1) that the metastatic growth appeared to arise in the medullary bone, to effect medullary and cortical bone destruction, and to elicit no periosteal reaction. The shape was usually oval. Twenty-seven of the tumors were less than 10 cm. and 8 more than 10 cm. in diameter. Extension to soft tissues occurred in 21 cases. Indistinct borders and an essentially osteolytic internal pattern were frequent observations.

Bone production, if it occurs at all, is not predominant, appearing as faint septa, calcific flecks, and small dense areas at the borders. The tumor appeared to cross the joint and involve adjacent bone in only 6 cases. In one instance serial studies showed actual progression through a joint into the articulating bone by direct extension. As judged by the roentgenographic studies, the tumors appeared to be relatively radioresistant.

A single case of marked inconsistency, a Hürthle-cell carcinoma, was included in the report. In this case the metastatic lesions were predominantly osteoblastic. Nevertheless, the studies indicate that to be of thyroid origin the metastasis should be either predominantly or purely osteolytic.

HOWARD B. BURNSIDE, M.D.
University of Arkansas

Osteoid-Osteoma. Fremont A. Chandler and Harry I. Kaell. Arch. Surg. **60:** 294–304, February 1950.

The authors present a review of the literature on osteoid osteoma, which they characterize as a benign osseous neoplasm of slow growth. They report 7 cases. The presenting complaint is usually pain, generally localized but occasionally referred. There may be swelling and limp, but never fever. The roentgenographic appearance varies; early the focal neoplasm appears as a radiolucent area, oval in contour in cortical bone and rounded in spongy bone. Surrounding it is an area of dense sclerosis of varying size, which may later be the principal feature. Surgical excision is the only treatment advocated.

Six roentgenograms; 6 photomicrographs.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Erect Method of Myelography. A. L. Loomis Bell, Howard O. Wunderlich, Herbert C. Fett, and Champe C. Pool. Am. J. Surg. **79:** 259–263, February 1950.

The erect method of myelography is advocated as a means of reducing the number of false negative and false positive diagnoses of disk herniation. A No. 18 spinal needle is placed preferably in the interspace between L-3 and L-4; 12 to 15 c.c. of spinal fluid are removed, and 12 c.c. of pantopaque are injected. The stylet of the needle is replaced and the needle is left in position. The patient is put in the erect position and exposures are then made in the upright weight-bearing posture, as follows: postero-anterior, right and left oblique, and lateral projections. Following this, fluoroscopy is done with the patient in the prone position to delineate the upper lumbar region, and appropriate exposures are made. The pantopaque is then removed. The total time of the procedure is twenty to thirty minutes.

It is felt that this method offers a better demonstration of the defect, since the patient is in the position of greatest stress and strain, *i.e.*, the erect position. The use of 12 c.c. of pantopaque is also felt to have advantages over smaller amounts.

Ten roentgenograms. PAUL W. ROMAN, M.D.
Baltimore, Md.

Osteitis Condensans Ilii: The Possible Relationship to Juvenile Epiphysitis. Walter H. Ude. Journal-Lancet **70:** 81–82, February 1950.

Osteitis condensans ilii is a condition recognizable only when seen on the roentgen film. It is characterized by a localized calcium condensation in the ilium directly adjacent to the sacroiliac joint, without any demonstrable pathologic changes in the joint or in the adjacent border of the sacrum. It occurs predominantly in women, and is usually discovered between the ages of twenty and forty. The etiology of the condition is still obscure.

The demonstrable abnormalities seen immediately subsequent to the termination of the active stage of the disease consist mainly of structural changes in the shape of the vertebral bodies, with a tendency toward wedge-shaped compressions, intra-osseous herniations of nuclei pulposi, or so-called Schmorl's nodes, and irregular cortical sclerosing changes around the margins of the vertebral bodies and the Schmorl's nodes. These changes produce variations in the curvature of the spine, mainly kyphosis, but also scoliosis, which is distinctly localized to the region involved. Slight narrowing of the intervertebral disks may be present, probably as an associated result of the Schmorl's nodes. In subsequent years degenerative changes develop in the involved areas of the spine, which consist mainly of hypertrophic marginal lipping. Cortical sclerosing changes somewhat like those in the ilium may develop in the margins of the vertebral bodies.

Six cases of osteitis condensans ilii are reported in which there was also noted the simultaneous presence of the residual changes, and the sequelae, of vertebral epiphysitis (Scheuermann's disease), suggesting the possibility of a common eticlogical factor. The author states as his immediate impression that the findings of osteitis condensans ilii may represent secondary sclerosing changes superimposed on juvenile epiphysitis of the sacroiliac joints, which would be comparable to the changes developing in any weight-bearing joint altered by a disease process.

GLENN F. MILLER, M.D.
The Henry Ford Hospital

Fracture of the First Rib. Its Occurrence and Clinical Diagnosis. F. I. Powell. Brit. M. J. **1:** 282–285, Feb. 4, 1950.

Fracture of the first rib is a clinical entity, occurring in young males and almost always in the region of the scalene tubercle. The present paper is based on 25 cases. Weight lifting, forceful hyperabduction, and trauma to the shoulder were the usual causes in the acutely painful cases. Some cases were found on routine films in patients without signs or symptoms; in others there was a slow onset of pain but no history of injury.

Four types of radiologic picture were seen: (1) a fracture line widening medially, (2) complete fracture with no displacement, (3) old fractures with minimal callus, resembling a pseudoarthrosis, and (4) those with well formed callus.

Of the 25 cases, none showed any definite evidence of damage to the brachial plexus or subclavian artery in spite of the close relationship of the fracture line to these structures.

Four roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Medial Epicondyle Injuries. Frederick M. Smith. J. A. M. A. **142:** 396–402, Feb. 11, 1950.

Injury to the medial epicondyle of the humerus is predominantly an injury of childhood or adolescence. The author lists five types:

(1) *Epiphyseal Trauma Without Separation:* These cases show localized tenderness with or without swelling over the epicondyle, and the roentgenogram is usually normal. No splint is necessary in the treatment. The use of a sling is advisable to allow partial rest and relaxation of the flexor muscles of the wrist.

(2) *Slight Separation of the Epicondyle:* Pain and tenderness are present over the bone process. X-ray examination will show the separation of the epicondyle. Treatment consists of complete rest with the arm and forearm in a posterior molded plaster splint and sling for four or five days. The splint should extend from the axilla to the wrist

(3) *Definite Separation of the Epicondyle, With or Without Dislocation at the Elbow Joint:* In cases of this type there is usually rather severe swelling with generalized pain and tenderness about the elbow. Anteroposterior and lateral roentgenograms will show the separation of the epicondyle from the diaphysis. Open reduction is not necessary unless there is evidence of ulnar nerve injury. Accurate replacement of the epicondyle is not important, as the displaced epiphysis will become healed to the medial collateral ligament of the elbow joint by fibrous union, and its displacement as much as 2 cm. distad should cause no significant complication.

(4) *Definite Separation of the Epicondyle With Displacement into the Elbow Joint:* Anteroposterior and lateral studies of the elbow in these cases show complete displacement of the epicondyle and the displacement into the joint space may be obvious. It may be necessary to examine the normal elbow for comparison. The author feels that this is the most serious and significant injury to the medial epicondyle and that open operation is indicated.

(5) *Fracture of the Medial Epicondyle in Adults:* This is an extremely rare injury and usually occurs in conjunction with other fractures into the elbow joint. Treatment is conservative, and no operative procedure should be performed unless there exists evidence of ulnar nerve trauma.

The author refutes the general opinion that injury to the medial epicondyle of the humerus is of serious consequence. Although an injury to a growing portion of bone had occurred, and almost half the patients showed irregularity of the medial epicondyle on follow-up examination, none demonstrated loss of function that could be directly attributed to this irregularity. Lack of perfect reduction of the displaced epicondyle, leading to fibrous union, caused no late disability or pain and discomfort. Failure to reduce the epicondyle did not lead to any recognizable subjective or objective weakness in flexor muscle power of the wrist. Failure to obtain reduction of the epicondyle

fragment did not lead to any late disturbance in the sensory or motor function of the ulnar nerve.

The author concludes further that the most important diagnostic point to remember is the possibility of displacement of the epicondyle into the elbow joint; that all epiphyseal ossification centers must be discernible (as compared with the uninjured elbow, if necessary) in their normal locations by roentgen examination; that conservative treatment is indicated in all cases except those in which intra-articular displacement of the epicondyle has occurred or in which the ulnar nerve has been injured; that the period of immobilization should be minimized and early active exercises should be instituted, within pain limits.

Four roentgenograms; 4 tables.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Acute Deposition of Calcium Near the Elbow. E. S. R. Hughes. J. Bone & Joint Surg. **32-B:** 30–34, February 1950.

The author describes three cases of localized deposition of calcium salts in the common origin of the extensors of the forearm. The characteristic symptoms are pain, tenderness, and swelling in the region of the lateral epicondyle of the humerus. Radiographs show an amorphous calcium deposit in the soft tissues. At operation this calcium was found to be within and deep to the tendons. Its evacuation resulted in prompt relief of symptoms and is therefore recommended as the treatment of choice.

The author regards this condition as analogous to the peritendinitis of the supraspinatus tendon of the shoulder and believes that it is the acute phase of "tennis elbow."

Six illustrations.

ROBERT R. ROSEN, M.D.
Mt. Sinai Hospital of Cleveland

Use of Radioactive Phosphorus in the Diagnosis of Avascular Necrosis of the Femoral Head. F. R. Tucker. J. Bone & Joint Surg. **32-B:** 100–107, February 1950.

Avascular necrosis of the femoral head following fracture of the femoral neck is due to vascular damage sustained at the time of injury, although inadequate immobilization, violence of manipulation, and the effects of some forms of internal fixation may play a part. Because modern methods of internal fixation diminish the amount of disuse osteoporosis, the roentgenographic difference between the dense, avascular femoral head and the osteoporotic shaft has been minimized. Thus the diagnosis is difficult to make until many months after the fracture. Since subsequent deformity of the head is due to weight-bearing on degenerated trabeculae, a correct prognosis as to the development of avascular necrosis may alter the method of therapy. For this purpose the author has used P^{32}.

About two hours before internal fixation of a fracture of the femoral neck, 150 to 200 millicuries of P^{32} are injected into the antecubital vein. At the time of fixation, bone specimens are taken from the greater trochanter and from the postero-inferior portion of the femoral head. The samples are then ashed and assessed by a Geiger counter. If the blood supply to the head has been interrupted, the sample of the head should contain much less P^{32} per unit of weight than the sample from the femoral neck. (There is always some P^{32} absorbed from the synovial fluid and surrounding hematoma.)

Thirteen patients were studied by this method. In 2 cases where the ratio of P^{32} in the head, compared with that in the trochanter was 1:10 and 1:16, avascular necrosis was later apparent. In 1 case with a ratio of 1:5, a segmental necrosis developed. Slighter variations, 1:3, 3:2, etc., were not significant, and in none of these patients did avascular necrosis develop.

The dangers and complications of the procedure are briefly discussed and are sufficient to warrant care in its use. Nevertheless, this method offers a promise that it may be possible to detect a non-viable head at the time of internal fixation of a fracture of the femoral neck.

Four roentgenograms; 1 table.

ROBERT R. ROSEN, M.D.
Mt. Sinai Hospital of Cleveland

Transitory Eosinophilia Localised in the Knee Joint after Pneumarthrography. R. C. Murray and Elemér Forrai. J. Bone & Joint Surg. **32-B:** 74–83, February 1950.

In operations on the knee joint following air pneumarthography, the authors frequently observed a turbid effusion quite different from the clear straw-colored fluid usually associated with meniscal lesions. Examination of the fluid revealed that the turbidity was due to an increased cell count, with a high percentage of eosinophiles (average 35 per cent). The presence of turbid fluid was noticeably less if oxygen was the contrast medium used.

The eosinophilia is localized and does not appear in the blood; it is not connected with any change in the *p*H. It could not be established whether the appearance of the eosinophiles was primarily in the synovial fluid or in the synovial membrane.

Pneumarthrography has been considered as a relatively innocuous procedure, but this study disclosed that 10 of 17 complications following menisectomy occurred in cases in which a turbid effusion was present. The recommendation is made, therefore, that menisectomy be done either on the first day after pneumarthrography or delayed until after the tenth day, since it was shown that the effusion takes more than twenty-four hours to appear and will be absorbed by the tenth day.

Six tables.

GEORGE R. KRAUSE, M.D.
Mt. Sinai Hospital of Cleveland

Torn Discoid Meniscus: Association of Discoid Meniscus with Congenitally High Position of the Fibular Head. Michael Burman and Ernest Neustadt. Arch. Surg. **60:** 279–293, February 1950.

Congenital malformations of the fibular half of the leg resulting from failure of normal regression include discoid meniscus. This is the common cause of "snapping" of the knee in childhood. With or without injury, the discoid lateral meniscus may become torn or produce locking.

The more primitive animals have a tibia and fibula of equal length, or the fibula may participate in the knee joint. An abnormally long fibula is a common but not invariable accompaniment of discoid lateral meniscus in man. The roentgen signs suggestive of discoid meniscus are flattening of the lateral femoral condyle, widening of the lateral joint space, and high

fibular head. Arthrography and arthroscopy are sometimes helpful in diagnosis. Tears are usually in the anterolateral or posterolateral insertion of the meniscus and are likely to result in internal derangement of the knee joint.

Five cases are reported.

Eight roentgenograms. LEWIS G. JACOBS, M.D.
Oakland, Calif.

GYNECOLOGY AND OBSTETRICS

An Appraisal of the Value of Radiological Diagnosis in Obstetrics Based on Fifteen Years' Personal Experience. A. B. Nash. Am. J. Obst. & Gynec. **59:** 475–481, March 1950.

The author discusses the various types of roentgen examination in pregnancy that he has found of value in fifteen years of experience. For the first seven years he used the Thoms method of pelvimetry. He then discarded that procedure because he felt that it did not afford enough information about the midpelvis and because he sought greater technical simplicity. The technic that he now uses combines the Snow method and that described by McSweeney and Moloney. Nash believes classification of the type of the inlet is of limited value in predicting the mechanism and difficulties of labor, unless considered in conjunction with the similar characteristics of the midpelvis and outlet. When the problem of disproportion is concerned only with the inlet, the midpelvis and outlet presenting no problems, a trial labor affords the most accurate information.

The author feels that "the vast majority of cases of dystocia occur in the mid-pelvis and it is with regard to this plane that we have found x-ray pelvimetry to be of much value, particularly when the findings are given consideration in conjunction with careful appraisal of the pelvic cavity by palpation performed earlier in pregnancy."

The outlet can be measured fairly reliably by roentgen pelvimetry, but greater dependence may be placed on palpation and external measurements here, for this is the most accessible plane of the pelvis.

The plastic filter technic is used for visualization of the placenta. This examination has proved extremely accurate, and only rarely has it been found useful to confirm the diagnosis of placenta praevia by use of opaque media in the bladder or rectum.

Two cases are cited in which radiolucent collections of gas in the major vessels of the fetus made possible a diagnosis of fetal death in the absence of other roentgen signs.

Cephalometry has proved disappointing in the author's experience so far as practical accuracy is concerned. T. FREDERICK WEILAND, M.D.
Jefferson Medical College

Direct Parallax Method of Stereoscopic Pelvimetry. Chas. E. McLennan. West. J. Surg. **58:** 48–54, February 1950.

The author's indications for pelvimetry are given as follows: (1) clinical diagonal conjugate diameter less than 11.5 cm.; (2) clinical bituberous diameter (transverse of outlet) under 8 cm.; (3) apparent shortening of the ischial interspinous diameter, as determined by vaginal and rectal palpation; (4) nullipara at term, with unengaged presenting part; (5) primigravida with breech presentation and suggestive abnormality in pelvic morphology; (6) multipara with history of previous dystocia or injury to newborn infant conceivably related to pelvic size; (7) inability to measure diagonal conjugate accurately by clinical methods; (8) history of pelvic fracture or bone disease.

The commonest indication is lack of engagement of the fetal head in a nullipara at or near term. The technical details of the direct parallax stereoscopic method of roentgen pelvimetry are presented. The formula used is obtained by a simple geometric treatment of the triangles formed by the x-ray tube, the pelvic diameter, and the images on the superimposed stereoscopic roentgenograms.

Two roentgenograms; 2 drawings; 1 table.
MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

A Study of Midpelvic Contraction. Herbert Thoms and Robert H. Wyatt. Am. J. Obst. & Gynec. **59:** 424–428, February 1950.

Midpelvic contraction as indicated by a shortening of the transverse diameter (interspinous) of the midplane, with or without shortening of the midplane anteroposterior diameter, is definitely associated with increased operative intervention in labor. The midplane is defined as the plane which extends posteriorly from the lower posterior surface of the symphysis through the level of the ischial spines to the lower anterior surface of the sacrum.

The authors have considered all transverse diameters of less than 10 cm. as being evidence of midplane contraction. In a group of 320 cases it was found that where the transverse diameter ranged from 9.9 cm. to 9.6 cm. the incidence of operative deliveries was 37.8 per cent. This figure increased to 55.9 per cent when the transverse diameter was less than 9.6 cm., and to 63.5 per cent when such contraction was associated with midplane anteroposterior shortening.

It is concluded that roentgen pelvimetry of every primigravida should become a routine procedure. One such examination in a lifetime is usually sufficient.
HOWARD L. STEINBACH, M.D.
University of California

Incidence of Ureteral Obstruction in Benign and Malignant Gynecologic Lesions. Joseph P. Long and John B. Montgomery. Am. J. Obst. & Gynec. **59:** 552–561, March 1950.

The authors carefully review the literature regarding ureteral obstruction in gynecological conditions as well as evaluating 379 cases of benign and malignant gynecological lesions, which they have followed carefully by means of intravenous and retrograde urography. Their purpose was to determine the frequency of ureteral obstruction in a group of patients with extensive pelvic disease and to compare their findings with the observations of others. They noted that there was some form of urinary obstruction in about 50 per cent of their cases.

The highest percentage of urinary tract obstruction was associated with malignant ovarian tumors (70 per cent). Next in frequency were benign ovarian tumors (58 per cent), carcinoma of the cervix (53 per cent), pelvic inflammatory disease (49 per cent), and fibromyoma of the uterus (48 per cent).

A severe degree of hydronephrosis may be present

with no symptoms referable to the urinary tract, especially in patients with ovarian tumors and fibromyomas of the uterus. It was also noted that with benign pelvic lesions, unilateral urinary tract dilatation appeared more frequently on the right side.

The authors stress the importance of a survey of the urinary tract, both preoperatively and postoperatively, and reiterate the reversibility of these changes when they are caused by benign removable pelvic tumors.

Six roentgenograms; 5 tables.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

THE GENITO-URINARY SYSTEM

Urographic Study of the Upper Part of the Urinary Tract Prior to and After Cutaneous Ureterostomy and Ureterosigmoidostomy. Thomas L. Pool and Edward N. Cook. J. Urol. **63:** 228–231, February 1950.

This article presents a study of the status of the upper urinary tract of patients with carcinoma of the bladder requiring surgery for diversion of the urinary stream. The patients studied were operated upon in the Mayo Clinic between 1935 and 1948. Preoperative and postoperative findings are correlated with the general end-results of treatment.

Two types of operation were performed in two series of patients. In the first series, consisting of 100 cases, bilateral ureterosigmoidostomy and total cystectomy were performed either in single or multiple stages. The second series consisted of 14 cases in which total cystectomy was done after diversion of the urine by ureterostomy. It would appear that bilateral ureterosigmoidostomy was the operation of choice for diversion of the urinary stream in cases in which the preoperative urographic deformity was minimal or moderate; cutaneous ureterostomy for those with greater deformity.

All these patients were studied by excretory urography preoperatively. The examination consisted of studies of the outline of the kidneys as an expression of function of the renal parenchyma, and also the anatomic outline of the pelves, calyces, and ureters. Postoperative urographic studies revealed a great majority of cases showing dilatation of the upper urinary tract and disturbance of function, which was almost always bilateral.

The bearing of preoperative findings on the end-result is difficult to evaluate; it appears that the preoperative urographic findings have little or no relation to the postoperative findings. However, the authors found that patients with normal or with minimal urographic deformity seemed to show less morbidity and a lower mortality. They also believe that many patients died from the original tumor rather than from infection of the kidneys following operation.

SHIH-CHANG HWANG, M.D.
University of Pennsylvania

Nephrolithiasis and Nephrocalcinosis with Calcium Oxalate Crystals in Kidneys and Bones. Joyce S. Davis, W. G. Klingberg, and Robert E. Stowell. J. Pediat. **36:** 323–334, March 1950.

Calcification of the renal parenchyma in infants has been reported frequently. It usually is associated with dehydration, acidosis, gastro-enteritis, pyloric stenosis, or tetany. The calculi may consist of uric acid, urates, cystine, and calcium oxalate in acid urines, and calcium oxalate, carbonate, and phosphate and ammonium magnesium phosphate in alkaline urines.

A case of nephrocalcinosis of unknown etiology in a boy of three years is reported, with calcium oxalate crystals in the kidneys and bones. The patient had no evidence of chronic urinary infection and maintained a fairly adequate compensation and development despite very extensive renal damage. Roentgen examination revealed numerous patchy areas of calcification in both kidneys and impaired renal function. The skeletal system appeared normal. The patient was followed for nine years, with death at the age of twelve. It is suggested by the authors that this case represents an unusual disturbance of calcium oxalate metabolism.

Six illustrations, including 1 roentgenogram; 1 table.

HOWARD L. STEINBACH, M.D.
University of California

Fistulas Between the Kidney and Intra-Abdominal Viscera: Report of a Case of Acquired Renal Hepatic Fistula. Joseph A. Lazarus. J. Urol. **63:** 218–223, February 1950.

The author presents a brief review of the literature on renal fistulas and presents a case, the first to be reported, of a fistula between the liver and the kidney.

A 57-year-old female had a cystic mass in the right upper quadrant. At operation this was found to be a benign adenomatous cyst of the liver. Two weeks later hematuria developed, and a tube in the abdominal incision began to drain urinous fluid. A retrograde pyelogram showed the dye in the dilated lower calyx to be in contact with the drainage tube. There was an acute angulation of the ureteropelvic juncture.

Weekly lavage of the right renal pelvis was instituted, and roentgenograms no longer showed a communication between the lower calyx and the liver cavity. The value of proper drainage in causing spontaneous healing of fistulas between the kidney and other viscera was thus demonstrated.

Three roentgenograms; 2 drawings.

ROBERT J. AYELLA, M.D.
University of Pennsylvania

Retrocaval Ureter: A Case Report. Donald E. Beard and William E. Goodyear. Urol. & Cutan. Rev. **54:** 80–82, February 1950.

Retrocaval ureter is an anomaly in which the right ureter passes posterior to the vena cava as it descends from the kidney to the bladder. The symptoms are those produced by any type of hydronephrosis not due to calculus.

On the excretory urogram one may seen the characteristic "fishhook" or "S"-shaped deformity which is produced by the ureter as it turns medially in its upper third to course around the vena cava. In retrograde studies the ureteral catheter is deviated medially in its upper third and then makes a sharp turn laterally to enter the normally located kidney. Two other roentgen procedures may be of aid. A venogram of the vena cava, obtained by injecting contrast substance into the right femoral vein while a ureteral catheter is in place, will demonstrate the ureter passing medially to the vena cava. A much more formidable procedure is catheterization of the vena cava and the ureter simultaneously, for a study of their relationship by stereoscopic views.

Nephrectomy of a diseased kidney is the treatment of choice if the opposite kidney is normal. Division of the vena cava is suggested when the opposite kidney is absent or diseased.

Four roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

THE BLOOD VESSELS

Arteriographic Examination of the Lower Extremity. Darrell A. Campbell and R. Glenn Smith. Angiology **1:** 100–105, February 1950.

While arteriographic examination of the lower extremity will not solve all the problems that confront the surgeon interested in diseases of the vascular system, it has the following advantages: (1) It is a direct method. It actually demonstrates the point or points of obstruction, and the degree of collateral development is seen. (2) It is a visual method. One can actually see the functioning outline of the vessels. It also furnishes a graphic record, capable of being filed away for future reference or compared with similar studies. (3) It affords an earlier estimate of the prognosis than is otherwise possible. (4) It assists in determining the site of amputation. (5) It is of possible assistance in selecting candidates for lumbar sympathectomy. (6) It offers an opportunity for new therapeutic efforts.

The success or failure of arteriographic examination depends upon the care and attention to detail in its performance and the interest and intelligence in its interpretation. Correlation with history and physical examination is essential.

Technically, contraindications to arteriographic examination of the lower extremity include (1) a nonpulsatile vessel at the site of injection; (2) severe deformities or contractures which make roentgen exposure difficult; (3) sensitivity to the contrast material. Diseases of the vessels in themselves are no contraindication.

The technic is described briefly (see previous paper by same authors, Surgery **24:** 655, 1948. Abst. in Radiology **53:** 460, 1949).

Three arteriograms; 3 drawings.

TECHNIC; APPARATUS

Comparative Value of Axial Transverse Laminagraphy and of the Usual Laminagraphy. Neopolo Macarini. Ann. radiol. diag. **22:** 83–113, February 1950. (In Italian)

Axial transverse laminagraphy is a method developed by Prof. A. Vallebona (see Radiology **55:** 271, 1950), which permits the taking of laminagraphs of cross sections of the body. In patients with surgical conditions of the chest the information given by transverse laminagraphy was compared with the information given by the usual laminagraphic methods. The author states that the two procedures are complementary and that the use of both gives a tridimensional study. Transverse laminagraphy improves the accuracy of localization.

Ten roentgenograms. CESARE GIANTURCO, M.D.
Urbana, Ill.

A Table Unit for Fluoroscopic Examination of Infants. Martin M. Maliner. J. Pediat. **36:** 228–229, February 1950.

The author, in his search for a means of holding infants and small children for fluoroscopic examinations of the chest, has devised a table unit with a removable seat top, which permits examination in the erect position. The unit is adjustable so that the patient may be rotated to any position with security, without assistance, and with comfort to the examining physician.

One drawing.

Printing of Roentgen Negatives on Paper. Arne Frantzell. Acta radiol. **33:** 83–103, February 1950.

The basic difficulties of transferring the image on a roentgen negative, with its great density range, to a photographic print are reviewed. The author has devised a method which utilizes a blurred image of the radiograph superimposed on the radiograph proper to neutralize much of the wide range of black-white density on the film. This neutralization process produces a considerable increase in detail and contrast. Illustrations are presented to demonstrate the value of this new method of printing of roentgen negatives, which is referred to in the literature as a "tone separation method."

The most important part of the apparatus is an instrument for the enlarging of 6 × 9-cm. negatives. An unsharp diapositive in diminished scale is first produced with the enlarging apparatus utilized as a camera. This diapositive is then enlarged and thereafter projected onto the roentgen negative, the different parts of which are thus illuminated in proportion to their density. Since the diapositive is blurred, the details of the original roentgen negative are preserved intact. The method is especially applicable in copying soft-tissue films.

Thirteen roentgenograms; 1 photograph.

I. MESCHAN, M.D.
University of Arkansas

RADIOTHERAPY

Plasmocytoma of the Nasal Cavity. Thomas A. Maguda and Sydner D. Maiden. Arch. Otolaryng. **51:** 258–262, February 1950.

After the skeleton, the upper respiratory tract is the most frequent site of plasma-cell tumors. Here they are commonly solitary and are considered as extramedullary, with a tendency to invade adjacent structures by continuity.

Extramedullary plasma-cell tumors of the nasal cavity occur most commonly after the fourth decade of life and are more frequent in men than in women. They are slow-growing, sclerosing, infiltrative, invasive growths, with considerable cellulosity and vascularity. The symptoms are nasal obstruction, epistaxis, and pain in the cheek, nose, or below the eyes.

The authors believe that the treatment of choice for large tumors in the nasal cavity is surgical extirpation combined with the use of radium. In the case reported here, seven radon seeds of 1.04 millicuries each were inserted into the tumor, and eight days later surgical

extirpation was performed. After the wound was completely healed, roentgen therapy was given, for a total dose of 2,400 r (whether this represents air, skin, or tumor dose is not stated). The physical factors and time are not given. Six months later there was no evidence of recurrence.

Two photomicrographs.

HOWARD L. STEINBACH, M.D.
University of California

Treatment of Early Carcinoma of the Cervix Uteri. James A. Corscaden. Am. J. Obst. & Gynec. **59:** 272–281, February 1950.

Early carcinoma of the cervix implies that the cancer is limited to the cervix. The author uses the League of Nations classification but has subdivided Stage I into three groups. Stage I-*a* includes all those tumors which were not visible or palpable, including cases which were frankly invasive. Stage I-*b* indicates clinically appreciable lesions which were smaller than 1 cm. in diameter. Stage I-*c* includes all of those still limited to the cervix and above 1 cm. in size.

The technic employed in the application of intracavitary radium since 1937 is to insert 30 to 40 mg. of radium in tandem in the cervix and corpus and place a 10-mg. tube of radium in each lateral fornix and one against the cervix. The filtration is 1 mm. platinum with a secondary filter of 5 mm. of gauze in the vaginal plugs. These are left in place 100 hours. The dose received by the external os is 18,000 gamma roentgens, by the paracervical region 11,580 r, and by the lateral pelvis 1,500 r. Roentgen irradiation through two anterior and two posterior ports, 10 × 15 cm., directed laterally (200 kv., 1 mm. Cu and 1 mm. Pt filter, 50 cm. anode-skin distance) for 200 to 400 r daily dose to a total of 2,000 r (measured in air) to each port, gives additional radiation of 3,886 r in the cervical mass, 3,886 r in the paracervical region, and 2,546 r in the lateral pelvic region.

Six patients with Stage I-*a* lesions were treated, and all were well after five years. Of 8 patients in Stage I-*b*, 7 or 88 per cent survived five years. Of 37 patients with Stage I-*c* lesions, 26 or 70 per cent have survived five years. Seventy-six per cent (83 per cent relative) for Stage I League of Nations, and 43 per cent absolute (46 per cent relative) five-year cures were achieved during the years 1939 to 1943 in 149 cases, of which 51 were Stage I.

The results obtained by operative treatment of carcinoma of the cervix are definitely no better than and, in general, slightly inferior to those obtained from intracavitary use of radium combined with external roentgen irradiation.

Transvaginal application of x-rays to the single large field gives promise, but shows no superiority over intracavitary radium combined with roentgen therapy. The results of the multiple-field technic have not yet been reported in a sufficient number of cases to be of statistical value.

The interstitial use of radium has produced superior results in the hands of a few therapists, who should continue to improve the technic, since by it one can attain a high gamma roentgen dosage in the parametria.

One illustration; 5 tables.

HOWARD L. STEINBACH, M.D.
University of California

Carcinoma of the Cervix (University Hospitals, 1926–1942). J. H. Randall, W. C. Keettel, H. C. Willumsen, and J. W. Scott. Am. J. Obst. & Gynec. **59:** 285–295, February 1950.

Between July 1, 1926, and September 1942, 983 patients with cervical carcinoma were treated at the University of Iowa Hospitals. Irradiation was employed almost exclusively, although a few patients were treated surgically.

The plan of therapy since 1937 has consisted of a course of deep x-ray therapy to the pelvis through six to eight portals, two anterior and two posterior (15 × 20 cm.), two lateral (15 × 10 cm.), two gluteal (10 × 10 cm.), and in some cases a perineal port. The following factors are used: 200 kv., target distance 50 cm., filter 2 mm. of Cu. The dosage to each port at any one treatment is 200 r, measured in air. The average dose delivered to the parametrial region is 3,500 to 4,000 r. Late in the course of x-ray therapy or at its conclusion radium is applied. Two 25.0-mg. tubes with 1.5 mm. platinum and 1.0 mm. of rubber filtration are placed in tandem in the uterine cavity, and six 10.0-mg. tubes with 1.5 mm. of platinum filtration are placed against the cervix in a brass block. The radium is left in place for fifty or sixty hours, or until 5,500 to 6,500 mg. hr. have been given.

For the entire group of 983 cases, the absolute five-year survival was 30.4 per cent. From July 1, 1926, to Sept. 1, 1937, there were 29.6 per cent five-year survivals among those patients treated with combined radium and x-rays. In the period from Sept. 1, 1937, to Sept. 1, 1942, there was an absolute five-year salvage of 39.4 per cent.

The stage of the disease is the most important factor in end-results. There were 87.8 per cent five-year survivals in Stage I (Schmitz) cases. The survival rate in Stage II cases was 64.8 per cent and in Stages III and IV, 32.5 and 3.5 per cent respectively.

In general, it was found that exophytic carcinomas responded better to radiation than did endophytic. The five-year survival percentages were 45.1 and 30.9 respectively.

Of those patients who had no febrile reaction during treatment, there were 36.4 per cent surviving five years, as against 16.3 per cent five-year survival of patients who had fever.

Thirteen tables.

HOWARD L. STEINBACH, M.D.
University of California

Carcinoma of the Cervix. Statistical Evaluation of 1,938 Cases and Results of Treatment. John McL. Morris and Joe V. Meigs. Surg., Gynec. & Obst. **90:** 135–150, February 1950.

A statistical review is made of 1,938 cases of carcinoma of the cervix which were seen during the years 1927 to 1942. More than a third of the cases occurred between the ages of forty-five and fifty-five years, and two-thirds between the ages of forty and sixty-five. The average age was fifty-one years. The majority of the patients has passed the menopause. The parity rate of the series was 84 per cent as compared with 68.9 per cent for the female population, aged thirty-five to seventy-four years (on the basic of the 1940 census). This high parity rate generally is accepted as an etiologic factor on the basis of the laceration and resultant irritation of the cervix. The intensive hormone stimulation during pregnancy may also play a part. Seven and three-tenths per cent of the patients

had evidence of syphilis, which is significantly higher than the control figure of 2.2 per cent from Massachusetts State cancer hospitals. Three and a half per cent of the patients had, in addition to cancer of the cervix, another known primary carcinoma. Skin and breast were more common sites for these than all others combined.

Vaginal bleeding was the most common symptom, occurring in 86 per cent of the cases. Pain was present in 42 per cent and vaginal discharge in 32 per cent. Only 8 patients were asymptomatic. Of patients with symptoms of less than three months duration, there were approximately twice as many with proliferative fungating growths as with infiltrating ulcerative lesions. Among those patients with symptoms of more than twelve months duration, this ratio was almost reversed, indicating that proliferative tumors give more severe early symptoms than the infiltrating lesions.

The survival statistics were compiled essentially according to the requirements of the League of Nations Health Organization. The inaccuracy of clinical staging has been shown in the radical operations for cancer of the cervix, in which 18 per cent of Stage I cases were found to have positive nodes. Also some cases clincially Stage I or II were found to have extensive pelvic or abdominal spread. There were 1,710 squamous carcinomas, 102 adenocarcinomas, and 67 miscellaneous lesions in this group. No significant correlation could be made between the histologic type of the tumor and survival.

There had not been any "standard" treatment of carcinoma of the cervix in this series. This has resulted in so many variables that it has been impossible to analyze accurately all the survival results, as the subdivisions become statistically insignificant. On the basis of clinical studies, local recurrence in the pelvis was seven times more frequent than distant metastasis. However, in 205 autopsies done on patients with carcinoma of the cervix, 62 per cent showed distant metastases.

It has been shown by Meigs that radical surgery can be done safely with a good cure rate in selected cases. Because of the factor of selection, this cure rate cannot be compared with other series. The authors believe that, while the possibilities of surgery are being reexplored, the value of radiation has been proved and this should be the treatment for cancer of the cervix except for institutions equipped for investigative radical surgery.

Ten illustrations; 14 tables.

HOWARD L. STEINBACH, M.D.
University of California

Sternal Secondary Deposit of Breast Cancer Treated by Radium Implantation. W. Sampson Handley. Proc. Roy. Soc. Med. **43:** 83, February 1950.

A patient, aged 82, gave a history of operation for left breast carcinoma in 1918. In 1925 a swelling 2-1/2 inches in diameter appeared over the junction of the manubrium with the body of the sternum. Six tubes of radium totaling 275 mg. were implanted in a circle around the swelling, and tubes of 50 and 25 mg. in its soft center, for twenty-four hours. Pain and swelling disappeared in a few weeks. Later telangiectases developed over the treatment field. In 1943 a small nodule in the area was successfully treated by x-rays, and at that time a recalcification of the sternum was noted. In October 1949, twenty-four years later, the patient is reported alive and well.

One roentgenogram. ALFRED O. MILLER, M.D.
Louisville, Ky.

Metastases in Carcinoma. Analysis of 1000 Autopsied Cases. Herbert L. Abrams, Robert Spiro, and Norman Goldstein. Cancer **3:** 74–85, January 1950.

One thousand consecutive cases of malignant neoplasms of epithelial origin seen at autopsy at Montefiore Hospital for Chronic Diseases (New York) were studied to determine the distribution and extent of metastases.

Non-epithelial tumors were excluded, as well as skin cancer, which is almost never a cause of death. Few cases of uterine cervical carcinoma were included, perhaps because of the high percentage of Jewish patients.

The findings presented in tabular form do not lend themselves to abstracting, since in addition to site and frequency tables for the over-all series, there are individual tables for the more common primary sites. It is useful, however, to have these percentage figures brought up to date for reference. The various factors which may affect the distribution of metastases as determined from such a series are discussed under the following headings: age, histology, type of patients composing the series, duration of life after diagnosis, treatment, and thoroughness of postmortem examination.

One graph; 17 tables.

[A paper by Abrams on the skeletal metastases in cancer, based presumably on this same series, appeared in Radiology **55:** 534, 1950—Ed.]

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

X-Ray Therapy of Non-Malignant Conditions. Paul W. Roman, and Stanley H. Macht. Virginia M. Monthly **77:** 71–74, February 1950.

The value of x-ray treatment of cancer is generally known. The effectiveness of radiation in treatment of infection is less well known and has been overshadowed by the sulfonamides and antibiotics. Most of the work in x-ray therapy has been done in relation to the treatment of cancer; considerably less has been done in the field of non-malignant conditions.

There are several theories as to the action of x-rays in treatment of non-malignant conditions, among which are: (1) destruction of the abundant leukocytes in the region of infection, liberating large quantities of antibodies and antibacterial enzymes; (2) formation of a non-specific antitoxin within twenty-four hours of the time of irradiation; (3) a rise in the phagocytic index; (4) an alteration of albumin-globulin ratio locally, with an increase in globulins.

There is usually a lag of twenty-four hours before the radiation effect begins. The peak is reached in forty-eight to seventy-two hours and begins to disappear gradually in approximately one week. Clinically pain may be relieved in from four to six hours.

Numerous articles from the literature are cited. Among conditions mentioned as responding satisfactorily to irradiation are subdeltoid bursitis, tuberculous adenitis, infective lesions about the face, acute postpartum mastitis, subacute sinusitis in children, ringworm of the scalp, virus pneumonia, Marie-Strümpell arthritis, hypoplastic nasopharyngeal lymphoid tissues, fungous infection of the hands and feet, human bite

infections, gas gangrene, herpes, otitis media and mastoiditis, parotitis, thrombophlebitis, hemangiomata, giant-cell tumor, uterine fibromata, pruritus ani and vulvae.

The authors list 19 different non-malignant conditions with which they have had experience. In 54 of the 70 cases good results were obtained; in 10 the results were fair and in 6 poor. Four cases are reported with details of treatment.

J. E. WHITELEATHER, M.D.
J. E. GARDNER, M.D.
Memphis, Tenn.

X-Ray Treatment of Some Non-Malignant Diseases. R. J. W. Charlton. South African M. J. **24:** 81–85, Feb. 4, 1950.

The author presents the following list of conditions which he feels can be usefully treated by means of irradiation. It is impossible in a brief review to enumerate the dosages and physical factors used in the treatments. As a whole, the dosages used are quite similar to those in this country.

1. Conditions Arising from Physiological Aberrations:
   (*a*) Ovarian and pituitary stimulation for oligomenorrhea and sterility.
   (*b*) Sterilization for menorrhagia.
   (*c*) Uterine fibromata *except* submucous polyp.
   (*d*) Endometriosis.
   (*e*) Enlargement of thymus.
   (*f*) Thyrotoxicosis.
   (*g*) Chronic interstitial mastitis.
2. Skin Conditions:
   A. Non-Inflammatory:
      (*a*) Hemangiomata.
      (*b*) Plantar warts, callosities and verruca vulgaris.
      (*c*) Pigmented moles (only if malignancy is suspected after coagulation).
      (*d*) Hyperkeratoses.
      (*e*) Leukoplakia.
      (*f*) Hyperhidrosis (hands, feet, and axillae).
      (*g*) Pruritus—anal and vulval.
      (*h*) Alopecia areata.
      (*i*) Psoriasis.
      (*j*) Lichen planus.
      (*k*) Keloids.
      (*l*) Pterygium.
   B. Inflammatory:
      (*a*) Acne.
      (*b*) Boils and carbuncles.
      (*c*) Dermatophytoses.
      (*d*) Kala azar.
      (*e*) Lupus vulgaris.
      (*f*) Herpes zoster.
      (*g*) Granuloma pyogenicum.
3. Inflammation or Hyperplasia of Lymphoid Tissue:
   (*a*) Enlarged chronic inflamed tonsils.
   (*b*) Hyperplasia of adenoidal tissues.
   (*c*) Chronic infection of lymph nodes, especially tuberculosis.
4. Chronic Arthritis:
   (*a*) Hypertrophic osteoarthritis.
   (*b*) Spondylitis ankylopoietica of Marie-Strümpell (active and acute stage).
5. Abnormal Calcifications:
   (*a*) Pellegrini-Stieda disease.
   (*b*) Calcification in supraspinatus tendon.
   (*c*) Peroni's disease.
6. Infections:
   (*a*) Parotitis.
   (*b*) Arachnoiditis.

S. F. THOMAS, M.D.
Palo Alto, Calif.

Roentgen Rays in the Treatment of Cutaneous Diseases: Limitations and Contraindications to Their Use. C. Guy Lane. Arch. Dermat. & Syph. **61:** 426–432, March 1950.

In the author's opinion, it is essential that in the training of the dermatologist in roentgen therapy at least as much emphasis should be placed on the contraindications to treatment and limitations of this mode of therapy as on its value. The value of roentgen rays in the treatment of pathologic changes of the skin has been amply demonstrated. Present-day apparatus is excellent, and the technic of therapy has become well established. The time has passed, however, when irradiation should be used for treatment of every dermatologic entity or every case of a disease known to be favorably influenced by this means. Indications for its use are founded on a very large clinical experience and the known effects of radiation on tissue cells. It is still necessary for one to know when not to treat and when to stop treatment.

Certain limitations and contraindications to the use of roentgen rays in dermatology are imposed by factors in the apparatus and technic, by factors in the individual patient, by the type and stage of the disease, by the dose to be used and frequency of treatment, and by the total dose to be prescribed. Careful observance of the limitations and contraindications will be a greater guarantee of good results in the rational use of roentgen rays in the therapy of diseases of the skin.

Chronic Respiratory Diseases in Infants and Children. W. Price Killingsworth and Fred Y. Kuhlman. Texas State J. Med. **46:** 92–97, February 1950.

The authors review past trends in the roentgen treatment of inflammatory processes and point out that there remain today many patients who should be offered the beneficial effects of radiation therapy, particularly infants and children with upper respiratory infections. Sulfonamides and antibiotics have been extremely useful in the treatment of many infections, though there are frequent cases wherein these drugs fail or prolonged use is not warranted. In other instances a surgical procedure may be contraindicated at the moment and some relief may be obtained with radiation.

Emphasis is placed on small doses, so that there is no possibility of damaging effects. When radiation therapy fails to affect the inflammatory process favorably, it will have no effect at all.

The authors report results of radiation therapy in 341 infants and children over a period of two and a half years. These patients had chronic respiratory diseases which had not responded favorably to sulfonamides and/or antibiotics or were thought to have received too prolonged medication. All children in the series had complete laboratory studies.

Of the total, 137 patients were treated for recurrent upper respiratory tract infection with 80 per cent showing clinical improvement in from one to five weeks; 75 per cent of this group still had their tonsils and adenoids.

There were 117 patients treated for chronic non-

specific bronchitis, with relief in 77 per cent. These patients exhibited enlarged mediastinal nodes with or without prominent bronchial markings; 25 per cent of this group retained their tonsils at the time of treatment.

Allergic bronchitis was treated in 57 cases, with beneficial results in 87 per cent. Radiation therapy in this type of case, however, is recommended only as an adjunct and not as a sole method of treatment.

Chronic sinusitis was treated in 30 patients, and the authors were not pleased with the results.

Series of 3 to 5 treatments were given; 13 per cent of the total cases received a second series six to eighteen months after the first. Physical factors were 140 kv., 20 ma., 50 cm. distance, and 0.25 mm. Cu plus 2.0 mm. Al filtration. Dosage was 100 to 150 r per treatment. The interval between treatments varied from two or three days to a week.

Three tables.

RICHARD A. ELMER, M.D.
Cleveland City Hospital

Value of X-Ray Therapy in Amenorrhea and Sterility Associated with Endometrial Hyperplasia. Samuel A. Wolfe. Am. J. Obst. & Gynec. **59:** 259–271, February 1950.

Endometrial hyperplasia designates pathological overgrowth of endometrial glands, stroma, and blood vessels resulting from prolonged or excessive estrogenic stimulation. The lesion is the result of persistent or excessive numbers of follicular cysts in the ovary. Abnormal uterine bleeding is the prime clinical symptom but, paradoxically, amenorrhea and hypomenorrhea may be produced. Sterility is present because of the absence of ovulation. In the blood and urine the gonadotropic values are generally low, but estrogen values show no distinctive pattern. The vaginal smear shows a high number of flat squamous cells. The uterus is normal or slightly enlarged, and the ovaries often are enlarged and even cystic. The diagnosis is established by histologic study of an endometrial biopsy or curettings.

The author believes that in patients with endometrial hyperplasia irradiation of the ovaries should be employed therapeutically if other methods have proved unsuccessful. He reports 3 cases with amenorrhea and sterility which were treated by x-rays. Endometrial biopsies were obtained before and after irradiation and demonstrated a restoration of the tissues to a normal pattern. Two patients became pregnant and had spontaneous abortions shortly after x-ray therapy; later they again became pregnant and proceeded to full term without incident. The babies at birth and in early infancy were normal. A third patient had prompt return of menses from a proved secretory endometrium, but pregnancy was voluntarily excluded by contraception.

Both the pituitary and ovaries of all patients were treated.

Ten photomicrographs.

HOWARD L. STEINBACH, M.D.
University of California

Theory and Results of Electron Therapy with a Six Million Electron Volt Betatron. Gerhard Schubert. Schweiz. med. Wchnschr. **80:** 193–200, Feb. 25, 1950. (In German)

The author gives a brief introductory discussion of the ways of increasing the depth dose and of the construction of the betatron. The instrument at the University of Göttingen, from which the report comes, is relatively small, weighing about 350 kg. Its output of electrons is about 1,000 r/min. at 1 meter, but the corresponding x-ray output is low, at best only about 1 r/min. at 1 meter. This is one of the reasons that high-voltage studies have been confined to electrons.

Since the action of conventional x-ray therapy is indirect, through the formation of recoil or Compton electrons, there is a biological similarity between the two modalities. But fast electrons do not have exactly similar physical properties, especially in that very energetic x-rays may produce nuclear changes not to be expected from fast electron bombardment, at least in the 1 to 10 mev range. The principal biological difference is in the number of ionizations per centimeter of path; the lower the initial energy, the denser the secondary ion cluster. For beta rays in the 1 to 6 mev range, the mean path is about 0.2 microns, about 10 times as great as for the electrons resulting from 200 kv. radiation. The surface action of the 6-mev electrons is consequently less marked.

According to the "target theory" of action, radiation effects are due to the striking of a critical area or "target" of some 10 to 100 millimicrons. This target need not necessarily correspond to a microscopically visible structure. In the case of fast electrons, the cell behaves as if it contained a number of minute targets. The actions of 200-kv. x-rays differ appreciably because of the relative slowness of the electrons produced. This is well demonstrated by the lethal action on colon bacillus; the 50 per cent lethal dose being 2.2 kiloroentgens for 3-mev electrons, and 3.2 kiloroentgens for 180-kv. x-rays (h.v.l. 0.27 mm. Cu). In other cases the more intense concentration of the ions obtained with x-rays is advantageous. Thus, in chromosome fragmentation, where 15 to 20 ionizations are necessary for a result, x-rays should be more effective, as experiment proves them to be. In this case, barley seedlings were irradiated with 180-kv. x-rays (h.v.l. 0.25 mm. Cu) and with electrons of 4 mev at the rate of 250 r/min. A further proof of the target theory was attempted by comparing leaf length of the seedlings following irradiation of the ungerminated seeds of barley with 2- and 5-mev electrons and intermediate voltages. While a decided stunting was produced by a dose of 4000 r, the difference between the curves at various voltages was trifling.

In other instances no difference between the results with x-rays and fast electrons would be expected; such is the lethal effect on three-hour Drosophila eggs. This was confirmed by actual experiment. Some effects are the product of complicated actions and cannot lead to so clear-cut a result; *e.g.*, although the irradiation of germinated barley seedlings with over 1,500 r of either modality produces a marked stunting, doses of less than 1,500 r of fast electrons produce an excessive growth, a finding not observed with roentgen radiation.

One basic difference between the effects of hard radiations and fast electrons is the fact that electrons produce their maximum effect at a variable distance beneath the surface, depending on their initial energy. This maximum lies at about 30 per cent of the mean range. The exact location can therefore be controlled by varying the energy of the initial beam. Above 2 mev, range is almost a linear function of energy, being 2 cm. at 5 mev, 5 cm. at 10 mev, and 10 cm. at 20 mev. The biological effectiveness is of necessity worked out

experimentally, varying with the test object and conditions. For a like number of roentgens, it seems to be related to x-ray by a factor of 0.5 to 1 up to 1 to 1, depending on the object.

Since in clinical therapy chromosomal damage is one of the outstanding mechanisms of action, experiments on the relative effectiveness of the modalities on this action might apply to the therapeutic effect, suggesting that the effectiveness of the electrons is slightly less than that of the x-rays, r for r. But this is not rigorous; late damage is less likely to result from electron irradiation, even with overdosage, and other qualitative differences seem to be present, although they are not marked. These factors tend to complicate attempts at therapeutic application.

For clinical evaluation, a number of patients with various conditions were treated, about 70 in all. There were 43 carcinomas, of which 24 were of the cornifying squamous-cell type, including 7 of the lip, and 14 were of the basal-cell variety. These skin lesions were given 2,000 r at 50 cm. Recurrent breast cancer, either local or in the nodes, was treated in 5 patients with a dose of 1,000 r at 50 cm. In all there was a severe exudative and edematous reaction with ulceration, which healed in six to ten weeks, with a soft pliable scar. All patients showed primary regression of the tumor, but late results were not available at the time of writing.

Four photographs; 13 graphs; 1 table.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

RADIOISOTOPES

Concentration of I^{131} in Thyroid Cancer, Shown by Radioautography. A Study of 100 Consecutive Cases Showing the Relation of Histological Structure to the Function of Thyroid Carcinoma. Patrick J. Fitzgerald, Frank W. Foote, Jr., and R. F. Hill. Cancer **3:** 86–105, January 1950.

Using photographic emulsion as the base on which tissue sections were fixed and stained (after allowing the proper interval of exposure time for the radioiodine to act on the emulsion), the authors made a complete study of the concentration of I^{131} in thyroid cancer, primary and secondary. They found that as little as 6×10^{-5} microcuries of I^{131} can be detected in this manner.

Slightly less than half the cases showed any concentration in the lesions. The lesions which contained colloid were more apt to concentrate the I^{131}, but even in normal tissue some follicles contained none, probably indicating that, as in so many other organs, some areas are at rest at any given time.

When normal thyroid tissue is present the I^{131} seems less likely to be picked up by the malignant part of the thyroid. This suggests that the normal tissue should first be removed or destroyed before radioiodine is used therapeutically.

The article is recommended in the original to anyone interested in work with isotopes.

Fifteen radioautographs, including 8 in color; 8 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Hyperthyroidism. Treatment with Radioactive Iodine. Sergei Feitelberg, Paul S. Kaunitz, Solomon Silver, Norman Simon, Louis R. Wasserman, and Stephen Bennett Yohalem. Arch. Int. Med. **85:** 471–478, March 1950.

The authors report on the treatment of 184 hyperthyroid patients with I^{131}; 150 had diffuse toxic goiter, 4 had substernal goiter, 28 had adenomas, and 2 had clinical hyperthyroidism without evidence of enlargement of the thyroid gland.

The radioactive iodine (I^{131}) was in the form of potassium iodide and did not contain any significant amount of carrier iodine. It was standardized on the basis of the "New York" millicurie and was given orally, an average quantity of 8.2 millicuries being administered. The average dose was about 10,000 roentgen equivalents, or about 80 microcuries taken up per gram of thyroid gland. Forty-three patients received two treatments and 9 patients required three.

In the average case, subjective improvement was noted in two to four weeks after treatment, and objective improvement in four to eight weeks. The authors report the cure of 182 of the 184 patients treated, with the absence of post-therapeutic sequelae in 167. In 13 patients, hypothyroidism developed after treatment. Two patients were cured of hyperthyroidism but continued to have the progressive exophthalmos which they had before treatment.

It is concluded that, because of the simplicity of the method, the absence of important complications, and the excellence of the results, the use of internal irradiation with I^{131} is the treatment of choice in diffuse toxic goiter.

Three tables; 1 drawing.

HOWARD L. STEINBACH, M.D.
University of California

Production of Malignant Tumors in Rats with Radioactive Phosphorus. Simon Koletsky, Frederick J. Bonte, and Hymer L. Friedell. Cancer Research **10:** 129–138, March 1950.

The development of malignant neoplasms in rats has been observed in the course of studies on the late effects of radioactive phosphorus poisoning. Of 13 tumors, 10 were osteogenic sarcomas, situated most frequently in the jaw but occurring also in the spine, tibia, femur, and ilium. Four of the neoplasms metastasized to the lungs. There were three squamous-cell carcinomas involving the face and associated with exophthalmos.

The neoplasms occurred in animals which received (*a*) a single LD 50 of P^{32} (average latent period of 290 days) and (*b*) repeated doses of 1.5 μc. per gram of P^{32} (average latent period of 165 days). The incidence of tumor development was about 40 per cent.

Complete autopsies were performed on all rats which died or were sacrificed. In almost all animals routine microscopic sections of femur and vertebra were taken. Roentgenograms were made of the entire skeleton of most of the animals, usually at the time of death; x-ray studies were also made of the control group.

Atypical proliferation of bone was usually found in the rats receiving radioactive phosphorus and the lesions may have served as a precursor to malignant change.

Sixteen illustrations, including 7 roentgenograms.

Distribution of Radioactive Iodine in Mice With and Without Tumor 15091a after Injection of Radioactive Sodium Iodide. Charles D. Stevens, Mary Ann Meinken, Patricia M. Quinlin, and Paul H. Stewart. Cancer Research **10:** 155–161, March 1950.

Measurements were made of the distribution of I^{131} among the tissues of 206 mice killed either forty-five minutes or twenty-five hours after the injection of labeled sodium iodide in quantities varying from 0.0013 to 1.3 μg. of iodine per gram of mouse. Smaller quantities of I^{131} were found in the thyroid glands of mice with implants of tumor 15091a than in the thyroids of control mice, although the concentration of I^{131} in the blood was similar. Higher concentrations of I^{131} were found in the spleens of tumor mice than in their blood on some occasions. The explanation for this is uncertain. Splenic enlargement in mice without tumors was not a sufficient cause for such concentration of I^{131}. Compared to the concentrations of I^{131} in the sera, the livers and ear pinnae of mice contained lower concentrations of I^{131}, and their thymus glands contained higher concentrations than had been found in the corresponding tissues in rats, in an earlier study (Stevens, *et al.* Cancer Research **9:** 488, 1949. Abst. in Radiology **55:** 161, 1950). Otherwise, the distribution of the injected iodide was similar in mice and rats.

Age as Affecting the Osmotic and Mechanical Fragility of Dog Erythrocytes Tagged with Radioactive Iron. W. B. Stewart, J. M. Stewart, M. J. Izzo, and L. E. Young. J. Exper. Med. **91:** 147–159, Feb. 1, 1950.

Radioactive iron was administered to three normal dogs, two of which had previously been bled, in order to tag a group of erythrocytes of approximately known age.

The osmotic fragility of the newly formed tagged cells was significantly greater than that of the general cell population during the first few days after injection of the iron, while the mechanical fragility of the young cells was less than that of the general red cell population. As the cells aged and approached the end of their life span, their susceptibility to destruction by trauma inflicted by rolling glass beads exceeded that of the general cell population. The osmotic behavior of the old cells was not distinctive.

A decrease in circulating radioactive iron was observed in each experiment soon after the mechanical fragility of the tagged cells began to exceed that of the total cell population. The lowest point on the curve representing circulating radioiron was noted at 119, 119, and 122 days respectively after injection of iron in the three experiments. Estimates of the life span of dog erythrocytes obtained in this way agree with those provided by other methods.

Four graphs.

Rates of Turnover and Biologic Decay of Chloride and Chloride Space in the Dog Determined with the Long-Life Isotope, Cl^{36}. G. E. Burch, S. A. Threefoot, and C. T. Ray. J. Lab. & Clin. Med. **35:** 331–347, March 1950.

The authors report a study of the concentration-time course in the blood serum and turnover rates within the body in acute experiments and the concentration-time course, time-course of excretion in the urine and feces, and turnover rates for the entire body in six normal dogs observed continuously for eighteen to thirty-one days under controlled metabolic conditions, with long-life radiochlorine, Cl^{36} (to about 2×10^6 years) as a tracer substance.

Four charts; 7 tables.

The Circulation of Ascitic Fluid. Interchange of Plasma and Ascitic Fluid Protein as Studied by Means of C^{14}-Labeled Lysine in Dogs with Constriction of the Vena Cava. Frank W. McKee, William G. Wilt, Jr., Robert E. Hyatt, and George H. Whipple. J. Exper. Med. **91:** 115–122, Feb. 1, 1950.

For a study of ascitic fluid circulation, the authors used radioactive plasma obtained by feeding lysine labeled with carbon^{14} to donor dogs. Following both intravenous and intraperitoneal injection of the plasma thus obtained into dogs with experimentally induced ascites, a ready exchange of the plasma proteins between the ascitic fluid and the circulating blood was observed.

Three charts.

EFFECTS OF RADIATION

Some Biologic Effects of Long Continued Irradiation. Egon Lorenz. Am. J. Roentgenol. **63:** 176–185, February 1950.

Due to the large number of industrial and scientific workers now being exposed to ionizing radiations, it becomes of greater necessity to define more accurately the so-called "permissible" dose for man. The dose of 0.1 roentgen per day was based on scientific data wanting in completeness. The studies herein reported were begun in 1941 and are still continuing.

Mice, guinea-pigs, and rabbits were used with an exposure starting at maturity and continuing during the entire life span. Because of its ease and constancy of irradiation, gamma radiation from radium was used for these exposures. Dose levels were 8.8 r, 4.4 r, 2.2 r, 1.1 r and 0.11 r given in eight hours per day. For guinea-pigs the LD 50/30-day dose is approximately 300 r when given in a single exposure, while the mean lethal dose for to 4.4 r given eight hours per day is approximately 2,900 r or 650 days from the start of exposure.

In mice all radiation produced a shortening of the life span of some degree, the amount of shortening being in relation to the amount of radiation. Death was due to increased tumor incidence and in part to unknown effects, but there was no terminal anemia or leukopenia. In guinea-pigs, radiation death is due to pancytopenia. In the guinea-pigs exposed to levels of 0.11 r in eight hours per day, the average life span was slightly more than for the controls receiving no irradiation, but this is attributed to statistical error. Those guinea-pigs in the 1.1 r group had a slightly shorter life span than the control group, but none died of radiation injuries, indicating that the repair processes balance injury as far as the hematopoietic system is concerned. A wide range of tolerance was found for the various species, guinea-pigs being the most sensitive.

Among mice, it was found that (1) the young growing

animals are most susceptible to radiation-induced leukemia whether the radiation is given acutely or chronically, (2) the chronic irradiation of lower dosage rates does not materially influence the spontaneous incidence and tumor development time, and (3) tumors induced by irradiation seem to arise primarily in the thymus. It has been found (Kaplan) that part body irradiation in mice, whether this be of the upper half or lower half of the animal, causes no appreciable increase in the incidence of leukemia. However, mice of the same age and strain receiving whole body irradiation in the same dosage showed a high incidence of leukemia. If these conditions can be carried over and applied to radiologists, it would apparently indicate little danger of leukemia from ordinary fluoroscopic exposure. In guinea-pigs, chronic exposure to irradiation has no apparent effect on the incidence of leukemia.

The irradiated mice showed an incidence of lung tumors of approximately 75 per cent as compared to 45 per cent of non-irradiated mice. Such an increased incidence occurs only when the lungs are directly irradiated.

The incidence of mammary gland tumors is increased by chronic irradiation, especially at the higher levels, even though the mice become sterilized by a dose of approximately 900 r with a resultant reduced estrogen output. In addition, sarcomas of the mammary gland were encountered frequently in the irradiated mice but rarely in non-irradiated mice.

The incidence of ovarian tumors appears to be based on a minimal dose and not correlated with dosage rate. These tumors are the end-product of a series of changes in the ovary starting with a depletion of follicles, followed by tubular downgrowth and resulting finally in tumor formation. Irradiation causes a depletion of the follicles but apparently does not affect the subsequent steps.

A uterine tumor develops in some rabbits and this tumor shows a marked tendency to metastasize in irradiated animals receiving dosages insufficient to destroy the tumor, while such tumors in non-irradiated animals show very little tendency to metastasis. It has also been found, in this connection, that a transplanted mammary tumor in mice which does not metastasize ordinarily will metastasize when irradiated with doses insufficient for tumor destruction.

Experiments do not give a clear-cut answer to the question whether or not a daily dose of 0.1 roentgen also will cause a reduction in life span, but the data on higher dosage rates suggest that the reduction at this dosage level will be small.

Five graphs; 4 tables.

GEORGE G. REGNIER, M.D.
University of Arkansas

Radiobiological Additivity of Various Ionizing Radiations. Raymond E. Zirkle. Am. J. Roentgenol. **63:** 170–175, February 1950.

Additivity studies have been used in radiobiology for at least two decades. The general technic for testing the additivity of two radiations usually consists of a selected definite qualitative biological effect, such as the well known inhibition of hatching of Drosophila eggs.

Samples of the biological object are exposed to graded doses of each radiation, and dose-effect curves are obtained by plotting the degree of effect against dose. From these curves one can read off the dose of each radiation required to produce some convenient degree of effect such as 50 per cent hatching. Such a dose may be called a definitive dose. Therefore these doses, regardless of their physical magnitudes and the physical units in which they are expressed, are radiobiologically equal.

Zirkle reviews the work of others and offers tentative conclusions from all the available data. In numerous investigations, it has been found that the radiations producing high specific ionization are usually several times as effective per unit dose as those producing low specific ionization. Incomplete additivity of two radiations indicates some difference in mechanism. Complete additivity indicates that the mechanisms are identical in their most essential features—the determinative events—but not necessarily alike otherwise.

From the practical standpoint of radiation hazards it would seem at present, despite one investigation on mammals which indicates only partial additivity of gamma rays and fast neutrons, that it probably would be wise, pending information on more kinds of biological effects, to assume the worst possible situation, namely complete additivity.

One graph; one table.

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Cicatricial Comedos and Milia. F. Ronchese. Arch. Dermat. & Syph. **61:** 498–500, March 1950.

In 1947 (Arch. Dermat. & Syph. **56:** 537, 1947. Abst. in Radiology **51:** 294, 1948), Bluefarb called attention to the development of a ring of comedos around the scar of a facial epithelioma treated with roentgen radiation. The comedos were located in the area of clinically non-epitheliomatous skin included in or bordering the irradiated area. Since this report, the author has observed the same phenomenon in 3 cases of basal-cell epithelioma treated with 3,600 r, filtered, given in three exposures, administered every other day. In one of these cases not only a ring of comedos but also retention cysts (milia) developed.

The author believes the formation is a cicatricial radiation sequela which should happen in practically every case, at any age, provided the skin is furnished with a normally active pilosebaceous apparatus. On an ichthyotic facial skin, for example, with inactivity or absence of sebaceous glands, it should be impossible to produce comedos by cicatrizing roentgen exposures.

Six photographs.

The Acute Radiation Syndrome in Man. Shields Warren and John Z. Bowers. Ann. Int. Med. **32:** 207–216, February 1950.

When an atomic bomb explodes, two forms of penetrating radiation, namely gamma rays and neutrons, are instantaneously liberated in large amounts. This injury produces a collection of signs and symptoms, sufficiently unique to deserve the title, "acute radiation syndrome." In general, the most sensitive tissues are those characterized by the shortest life span and the most rapid metabolic processes. All cells vary in their sensitivity to radiation according to the phase of mitotic activity, the cell in early prophase being the most sensitive. The syndrome discussed is produced by near-total or total body exposure to excessive amounts of radiation, not by localized exposure.

The largest volume of data on man has been obtained by a study of the effects of the atomic bombing at

Hiroshima and Nagasaki. Approximately 100,000 survivors received from just sublethal to infinitesimal doses of ionizing radiation. Of these, a great majority are well, aside from the deformities referable to burns and other injuries.

The histopathological effects of radiation include changes in the cells, in the stroma, and in the blood vessels. The lymphoid tissue showed a disappearance of lymphocytes by the third day with resultant decrease in the size of the node. The lymphocytes returned slowly and at three months were still reduced in number.

As early as the fourth day the testes showed extensive necrosis of the germ cells with subsequent hyalinization. The ovaries showed less striking changes, characterized by an absence of corpora lutea.

In the gastro-intestinal tract early and pronounced changes occurred with mucosal edema, and pseudomembrane formation associated with extensive ulcerative change.

The acute radiation syndrome may take several forms according to the severity of the exposure. The *fulminating* form is characterized by the onset of nausea, vomiting, prostration, and mild diarrhea within two to six hours after exposure. These manifestations are associated with a pronounced fall in the white blood count. A step-like rise in fever and death occurs from the fifth to the tenth day. This happens in individuals receiving amounts of irradiation far greater than recognized lethal levels.

The *hemorrhagic* form of the disease presents initially nausea, vomiting, prostration, and, at times, mild diarrhea of about two days duration. Petechiae and purpura appear and are associated with frank bleeding from body orifices. Ulcerative lesions of mucosal surfaces become increasingly extensive and death may occur from three to six weeks after exposure. Patients in this group have received irradiation doses in the lethal or near lethal range.

A number of these patients will survive the three to six weeks period but exhibit continued weakness, pallor, and ulcerative lesions characteristic of the *pancytopenic* form of the disease. Cachexia may become pronounced and death ensue after a prolonged period of illness.

The *hematologic* responses are significant. Following exposure, a neutrophilic leukocytosis may persist for twenty-four hours. Patients examined the first few days after the bombings had a leukopenia which was most pronounced in the lymphoid series and subsequently in the myeloid elements. The platelet count fell less rapidly than the white blood count and was followed by a fall in the red blood cell count. Reticulocytes uniformly disappeared from the peripheral blood within a short time.

In the most severely injured cases the white blood count usually reached levels less than 1,500 per cu. mm. Examination of the blood films revealed lymphocytes predominating. The anemia continued to increase for a period of time after the white blood count had reached its minimum level. This finding is of importance in planning transfusion therapy.

In a group of Japanese men ten weeks after the explosions, instances of pronounced hypospermia or azospermia were found. In many individuals who survived, the sperm count returned to normal over a period of from six months onward.

Bacterial infections of a local or generalized nature may be prominent. In addition, the lungs in many instances showed areas of so-called "neutropenic" pneumonitis. In a number of the Japanese who exhibited the subacute type of illness lung abscesses developed; in others miliary tuberculosis ensued.

The treatment of individuals exposed to damaging amounts of ionizing radiation is at this date supportive and non-specific.

The statistics from Hiroshima and Nagasaki reveal that approximately 60 per cent of the deaths were due to trauma, 30 per cent to burns, and only 10 to 20 per cent to irradiation. Many individuals succumbed to trauma or burns before the ionizing radiation syndrome had developed. In all probability, many more would have died from irradiation had they been salvaged from the effects of trauma or burns.

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Survivors of Bombing of Hiroshima Three Years Later. Frederick George Novy, Jr. Arch. Dermat. & Syph. **61**: 379–383, March 1950.

Many articles have been written on the cutaneous injuries received by the victims of the Hiroshima bombing [see preceding abstract]. The author examined a group of the survivors of this bombing, and no cutaneous ionizing radiation effects were observed. The scars from the burns received were similar to those of ordinary "flash" burns.